29 MAY 1959

METAL INDUSTRY

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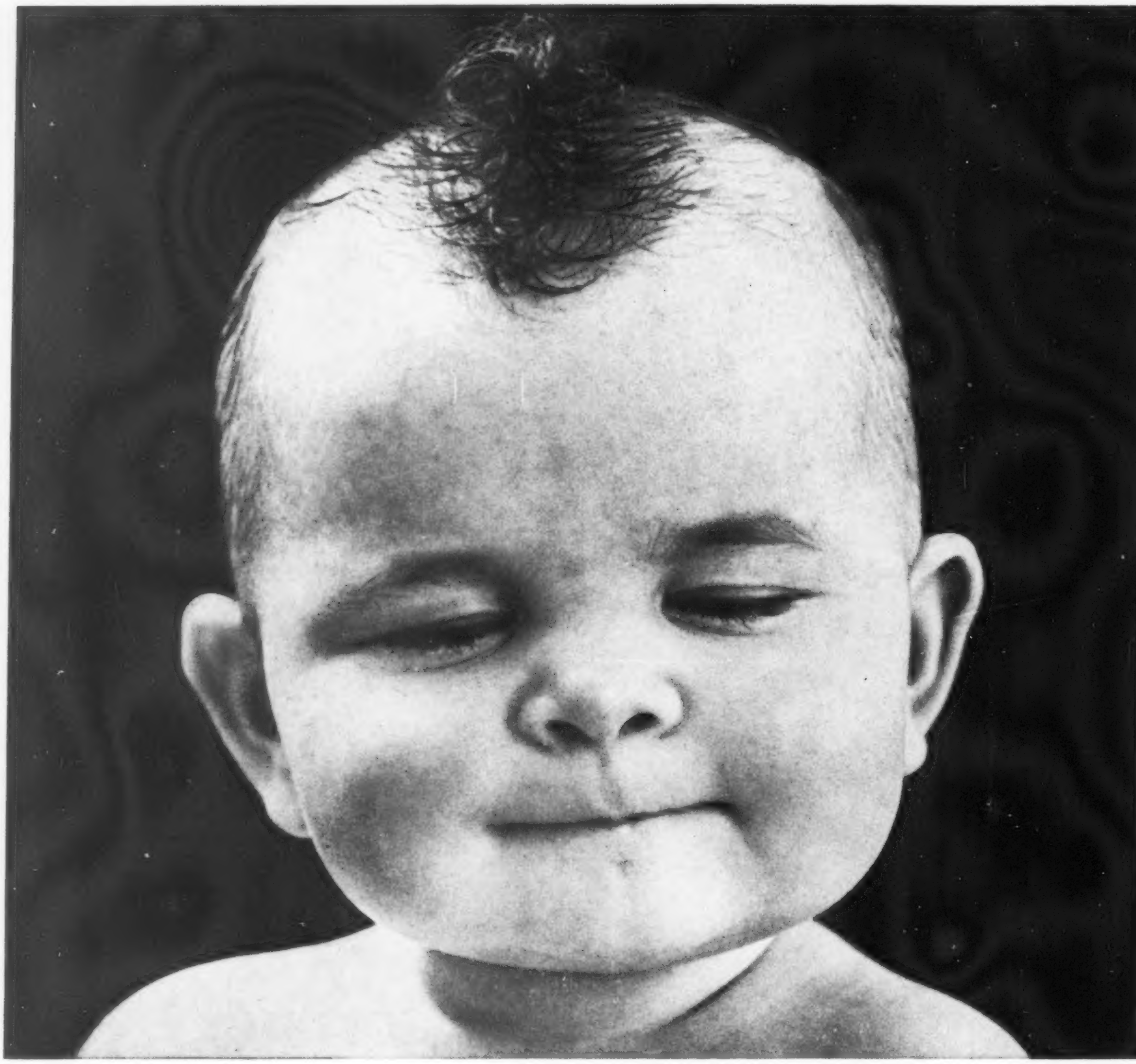

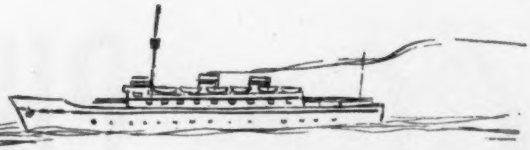

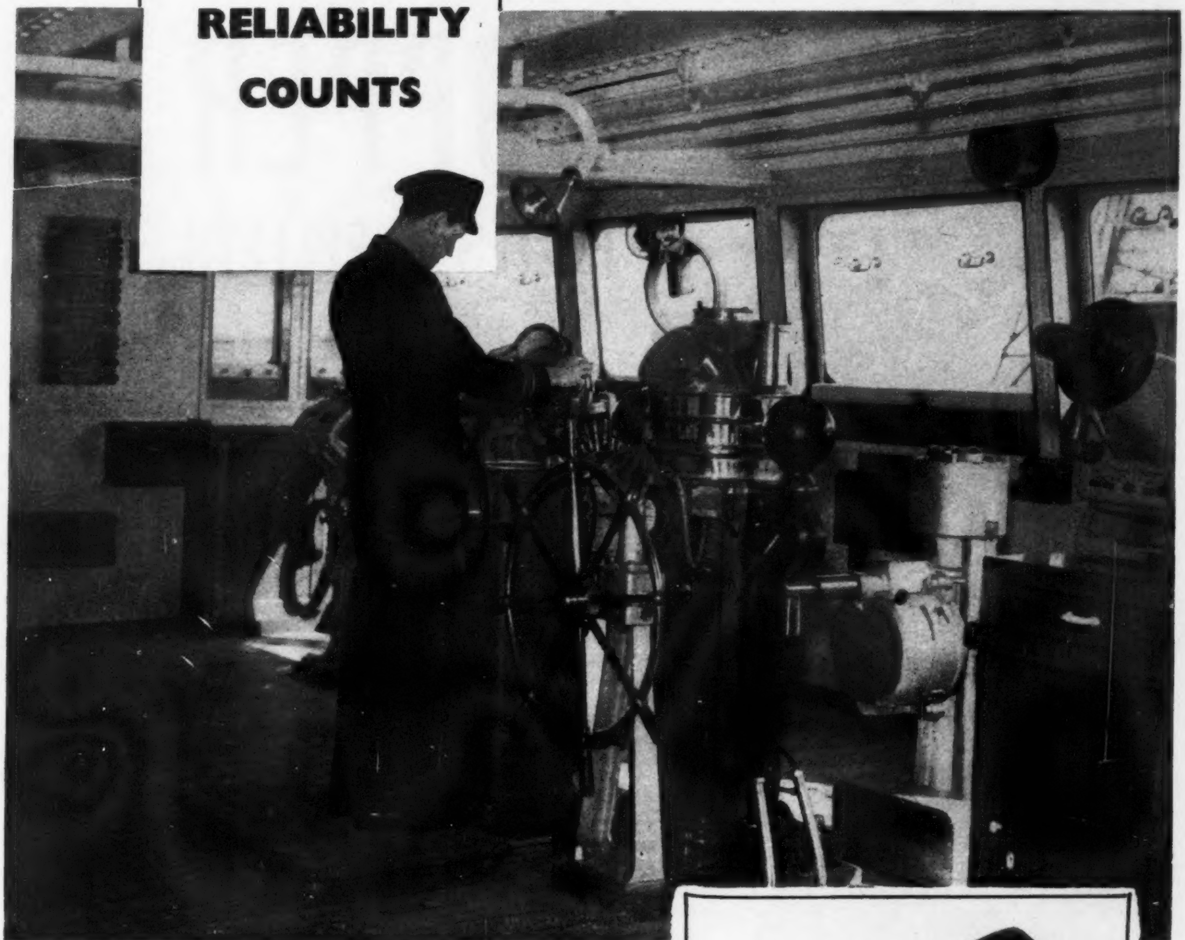

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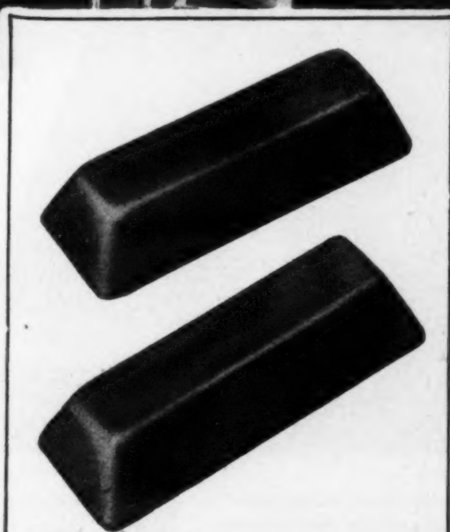

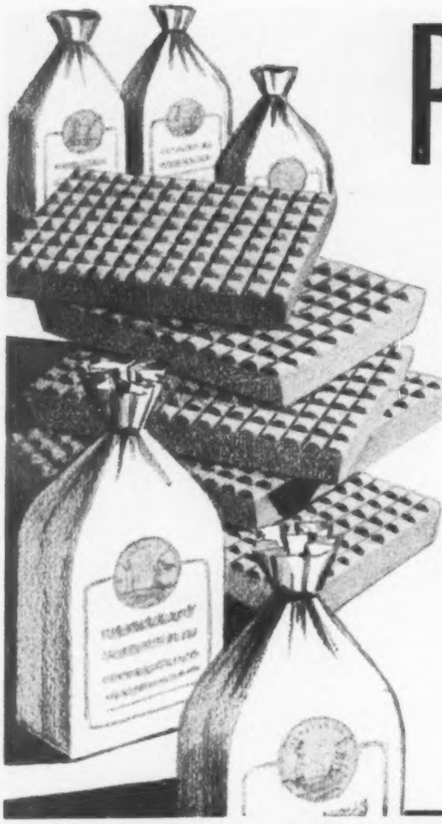

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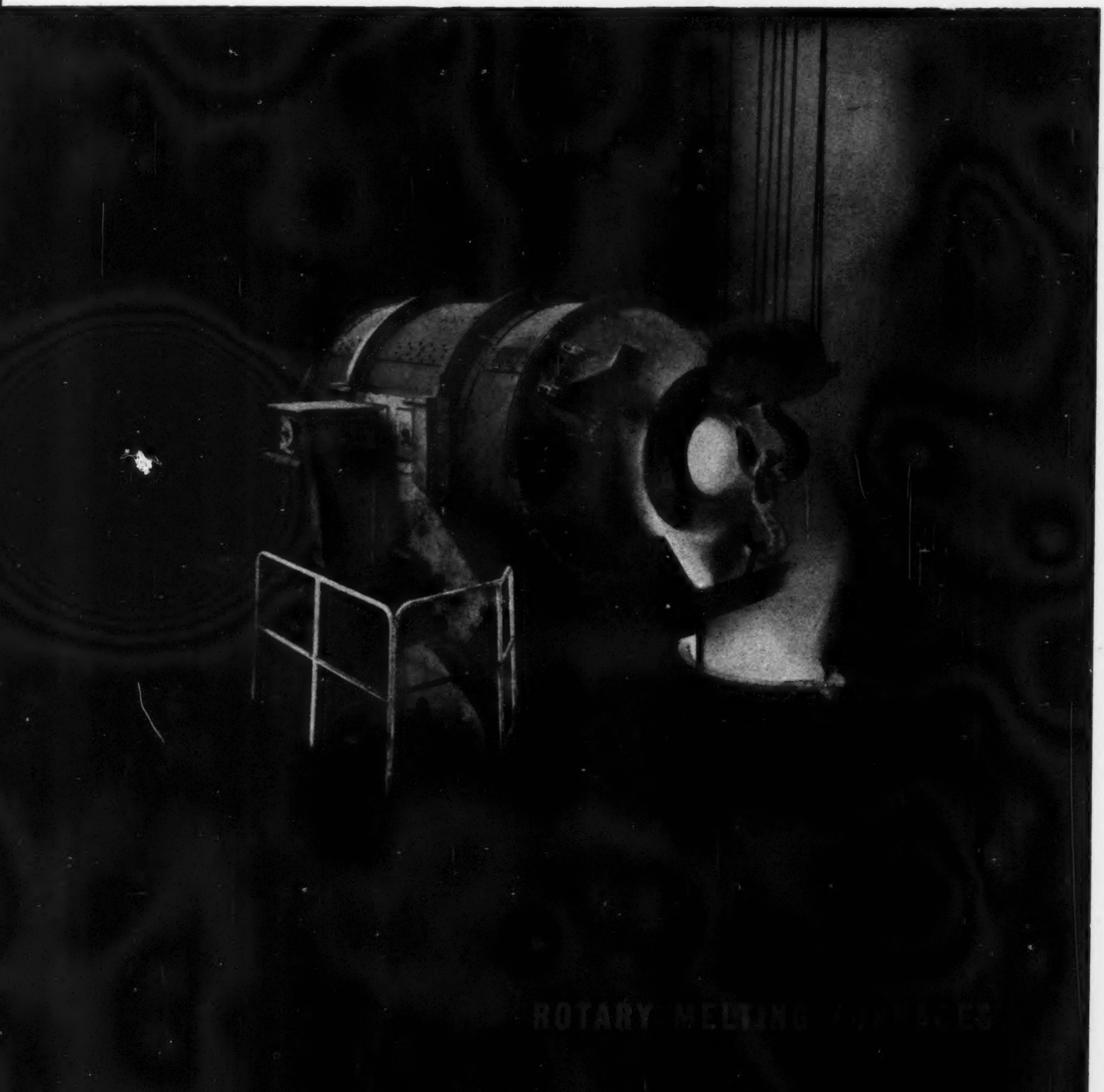
ROTARY MELTING

METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

29 MAY 1959 VOLUME 94 NUMBER 22

CONTENTS

	Page
Editorial: Prospects for Tin	439
Out of the Melting Pot	440
Control Techniques for the Small Foundry. *By A. R. Martin*	441
Grain Boundary Strength	443
Die-Casting Die Lubrication	443
Reviews of the Month	444
Finishing Supplement: Treatment of Precious Metals	445
Men and Metals	447
Modern Melting of Non-Ferrous Alloys. *By F. M. Bunbury and S. J. Rogers*	448
Industrial News	451
Metal Market News	454
London	
New York	
Birmingham	
Israeli	
Zurich	
Non-Ferrous Metal Prices	455
Scrap Metal Prices	456
Foreign Scrap Prices	457
Financial News	457
New Companies	457
Trade Publications	457
Light Metal Statistics	457
The Stock Exchange	458

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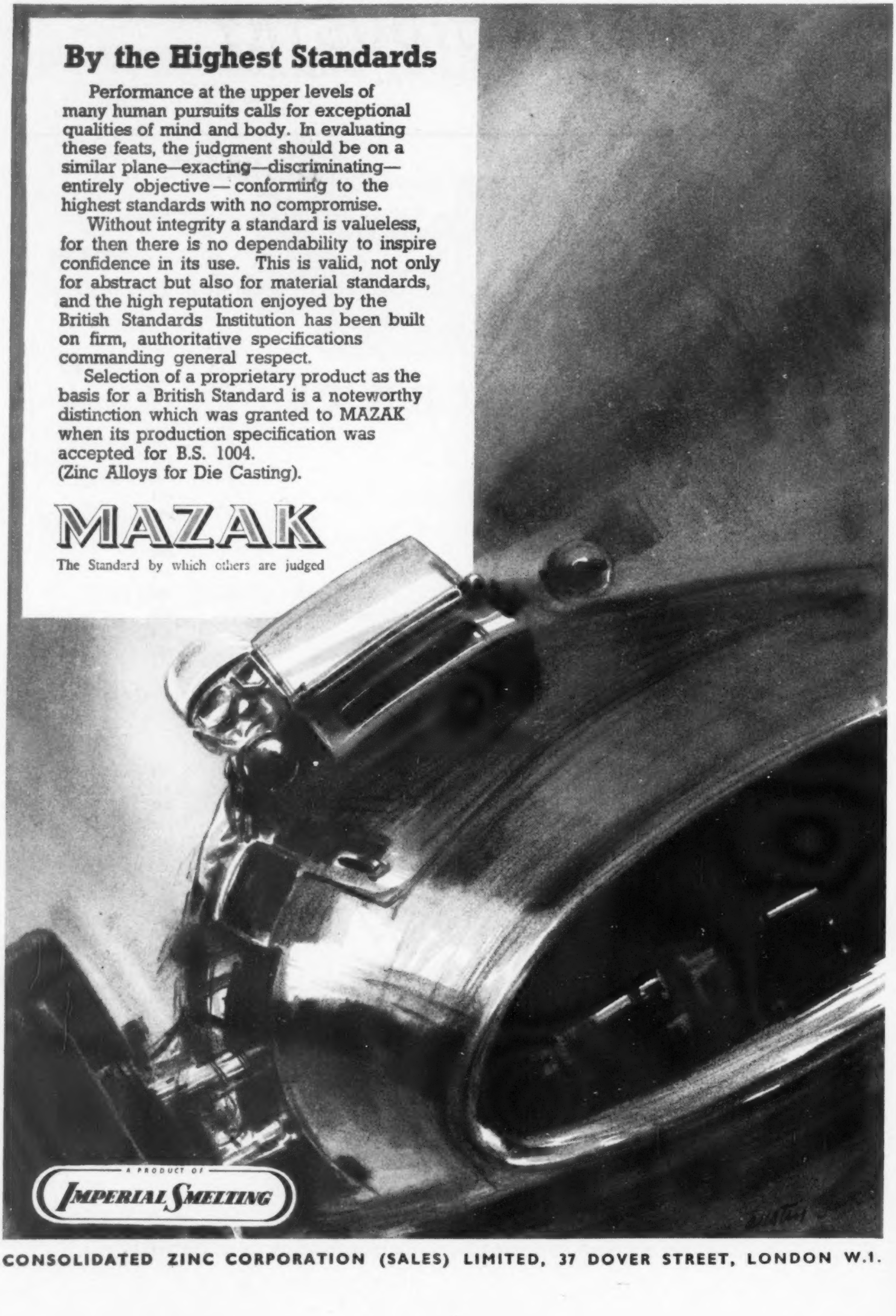
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METAL INDUSTRY

VOLUME 94 NUMBER 22 29 MAY 1959

Prospects for Tin

WORLD mine production of tin-in-concentrates rose to 11,100 tons in January last from 8,900 tons in December 1958. Output was higher in all the main producing areas. World consumption of primary tin was estimated to have risen to 13,400 tons in January last from 12,500 tons in December. During the fourth control period (October-December 1958), total exports of tin from the six countries participating in the International Tin Agreement were 19,891 tons; in other words, approximating to the total permissible amount. Although the current market position of tin is satisfactory, with the price steady just inside the middle price range of the agreement—£780 to £830 per ton—the immediate outlook presents some uncertainty. At the time of writing, the International Tin Council is meeting in Copenhagen and will, this week, fix quotas for the third quarter of this year (seventh control period). In arriving at their decision the Council will have to consider the definite possibility of a major strike in the United States steel industry which could seriously affect demand for tin, and the fact that demand is seasonally low in the third quarter of the year. Trade sources here expect that quotas will be left unchanged in order to leave a reasonable margin between the level of supplies and anticipated requirements.

A main point at this week's meeting of the Council will be the current position of the Buffer Pool. In recent weeks the manager has been able to dispose of tin, and the stock is currently estimated in some quarters to total around 18,000 or 19,000 tons. Further disposals are considered desirable in order to bring about a fair balance between cash and metal in the Buffer Stock to ensure the satisfactory operation of the agreement. No doubt there will be some pressure from producing countries upon the Council for further relief from the drastic curtailment of output, but trade quarters believe that, in view of the uncertainties in the market, they would be well advised not to press for too hasty de-restriction. After eighteen months of restricted activity, producing members of the Council are naturally anxious to bring more of their capacity into use, and they will certainly press their case strongly this week. No Soviet tin has yet appeared on the market this year, and some allowance must be made for supplies from that quarter in line with the understanding between the Council and the Soviet Trade Delegation.

On July 1 next, the Tin Agreement enters the last two years of its five-year lease and under the terms of the Agreement, the Council, when fixing quotas, must pay due regard to the necessity for reducing the quantity of tin held in the Buffer Pool by the time of its termination in July two years hence. Therefore, during the coming two years the Council may, if it wishes, instruct the manager to sell a specific quantity of tin during the forthcoming control period and this can, if required, be sold below £780 but not below £730. It is not likely, however, that this particular point need unduly cause concern to the Council at present if a reasonable call has already been made on the Pool's resources.

Out of the
MELTING POT

Flat Pipes

THE principle of expanding a flat metal product into a hollow tubular or like product by the application of air or hydraulic pressure to internal discontinuities in the flat product has been applied to the manufacture of products ranging from heat exchangers to pipes. Where the latter are concerned, the use of the process presents the possibility of transporting the flat unexpanded pipe and expanding it on the site where it is to be installed. This idea is particularly attractive in the case of pipelines: the transport of the coiled flat pipe to the site is so much easier than the transport of awkward lengths of piping. Experimental work on this technique reported from Russia was aimed at producing aluminium pipes of about 6 in. diameter and 0·12-0·16 in. wall thickness. Production started with 8 ft. to 10 ft. long hollow billets cut from semi-continuously cast lengths of 6 in. i.d. and $11\frac{1}{2}$ in. o.d. billet. The billets were coated internally with a mixture of talc and oil to prevent welding up of the bores and, after swaging down of one end, were rolled to 0·24-0·32 in. thick strip having a length of 140-150 ft. After trimming of the edges of the rolled product and the welding on of end flanges, the strip was coiled preparatory to transport to the site. On the site it was uncoiled by hand and then pulled straight, using a tractor. Blowing up of the pipe required an air pressure of 8 atm. The 6 in. diameter pipes were found to have a satisfactory finish on both the inside and outside surface, and acceptable wall thickness tolerances and mechanical properties. It is explained that the methods of production and the length of the pipes were determined by the nature and capacity of the equipment available, and could be modified, particularly with a view to reducing scrap losses due to edge trimming. This could be achieved by using hollow cast billets of suitable shape, or by rolling two superimposed rectangular slabs with stop-weld material between them.

Shall Not

AMONG the various "labours" that are being, or are to be, saved by the development of suitable labour saving methods and means, the labour of making decisions occupies a prominent position at present. In this connection, the availability of electronic computers, data processing machines, simulators, and such like equipment must be regarded as most fortunate. Such equipment is, indeed, admirably suited to perform most of the labour involved in making decisions: the labour of collecting and, if necessary, processing, all available relevant data that can serve as a basis for a decision, and the consideration—simulation, to use the technical term—of the consequences of any particular decision based on that data. If all this can be done by data processing equipment, the making of a decision could ultimately be reduced to the bare essential: given such and such existing circumstances and given the consequences of a particular course, should or should not the particular course be adopted. Decisions of this kind should prove easy. Whatever they prove to be, the labour saving equipment will have, at any rate, freed them from the risk of having overlooked some essential fact or of having failed to foresee some foreseeable important consequence. Labour saving could, of course, be carried still further. With all the available data to work on, and with the results of the simulation of all the possible consequences fed back to the equipment, the latter would only have to be set to solve a problem in optimization in order to arrive at the best possible decision. This possibility might well alarm those at present concerned with the making of decisions. Will all this electronic equipment render valueless their reputations of being able to make the right decisions, and will it ultimately do them out of their jobs? The answer is certain to be in the affirmative, unless those concerned realize that in making decisions their task is not to attempt to do what electronic equipment could do so much better—select the best possible consequences of existing circumstances—and unless they make up their minds to make the most important decision of their careers—the decision that electronic equipment shall not be allowed to take over. Should they fail to take such a decision, they will later, of course, only have themselves to blame.

Wider Implications

ASSUMING that specialization in any shape or form has certain undesirable characteristics and effects, it is reasonable to assume that some benefit might accrue from attempts to draw some general conclusions or the like from highly specialized bits of information. One such bit of information that can serve as an example concerns a process for shaping pyrophoric cerium-iron alloys by extrusion. The process is intended as an alternative to the present practice of producing "flints" by casting. Extrusion has been tried before, but the material produced was found to have unsatisfactory pyrophoric properties. This has been ascribed to the breaking down of the brittle cerium-iron crystallites, which are regarded as the carriers of the pyrophoric properties, by the deformation during the process of extrusion. As a means of avoiding this difficulty, it has been suggested to extrude alloys with a reduced iron content, and, therefore, a higher proportion of malleable eutectic, in which the cerium-iron crystals would be embedded and would thereby escape crushing during extrusion. A further step in the direction of facilitating extrusion and preserving the cerium-iron crystals has now been taken by the incorporation in the alloy of between 0·2 and 2 per cent of copper, the balance of the alloy being essentially 17 to 28 per cent iron and the remainder cerium (mischmetal). The copper forms a eutectic which melts at 415°C. and which will, therefore, normally be in the molten state at the extrusion temperature (400°-500°C.). The presence of this liquid phase lowers the extrusion pressure, facilitating extrusion and, above all, preventing any deterioration in the pyrophoric properties of the alloy as a result of extrusion. The generalization, at least in principle, of this specialized example is easy enough. It should be sought in the as yet little explored possibility of working suitable alloy compositions at temperatures at which they are in the pasty state. In this search, the pasty state may be approached by the partial melting of the massive alloy or by the heating of a mixture of alloy powders of the required composition. Given the alloy in the pasty state, working could then proceed by extrusion, rolling or other means, and might well be accompanied by cooling of the composition to the fully solidified state, some final working of which would then ensure satisfactory mechanical properties.

Skimmer

RECOMMENDED TESTS FOR ASSESSING CASTING QUALITY

Control Techniques for the Small Foundry

By A. R. MARTIN, B.Sc., A.R.S.M.

(*Concluded from* METAL INDUSTRY, 22 *May*, 1959)

ALTHOUGH the theme of this article is that, given a good control technique that is applied consistently, the end result will look after itself, it is nevertheless desirable to have some check, however rough and ready, that the required result is being achieved. This applies particularly to foundries with no testing laboratory of their own and who rely on the services of outside organizations for their test data. Fortunately there are one or two simple checks that do provide quite useful information. They do not require laboratory apparatus and require only a very minimum of preparation. These tests do not compete with laboratory control tests so that some comment on the reduced pressure test and tensile test has also been included.

The four tests chosen for comment are:— (a) the fracture test; (b) the diamond machining test; (c) the reduced pressure test; (d) the tensile test. They are taken in order of increasing complexity and cost of equipment rather than in the usual order following the sequence of the melting and casting operations.

The fracture test may be carried out on the finished castings themselves or on separately cast samples. Cost considerations will normally dictate that separately cast samples will be taken. The samples may be either chill cast or sand cast and of any convenient shape that allows them to be broken readily.

Sometimes, however, the information can only be obtained from the castings themselves.

Carless,[4] dealing with aluminium alloys states that the fracture test may be used to assess grain size and soundness. Only gross amounts of unsoundness will be evident in a sample fracture. When heat-treated castings are fractured, microporosity may be evident as discoloured patches on the fractured surface.

Metal mould reaction is normally evident on the surface of an aluminium alloy casting but may be confirmed by a fracture test. The fracture is outlined by a discoloured band and in severe cases it is not necessary to heat-treat the casting to observe this effect.

Assessment of the degree of modification of alloys treated with metallic sodium or with fluxes containing sodium fluoride is very readily carried out by means of a fracture test. The light grey, fibrous structure of the modified alloy is easily distinguished from the darker crystalline fracture of the unmodified alloy. With experience this test yields nearly as much information as the tensile test. In fact if thin section castings are being produced by the gravity die process, then the fractured castings provide an even more sensitive check than a tensile test.

Emley and Fisher,[5] dealing with magnesium alloys provide a Table in which are listed detailed descriptions of the types of fractures that may be expected. They also list diagnoses of the various defects described, together with suggested remedies.

Briefly they expect the test to provide information on coarse grain, microporosity and the presence of oxide.

French,[6] dealing with copper alloys states that, with experience, the zinc content of high tensile brasses may be estimated to within 0·5 per cent by judging the colour and number of facets in a test piece fracture. Similarly the aluminium content of an aluminium bronze may be estimated to within 0·5 per cent.

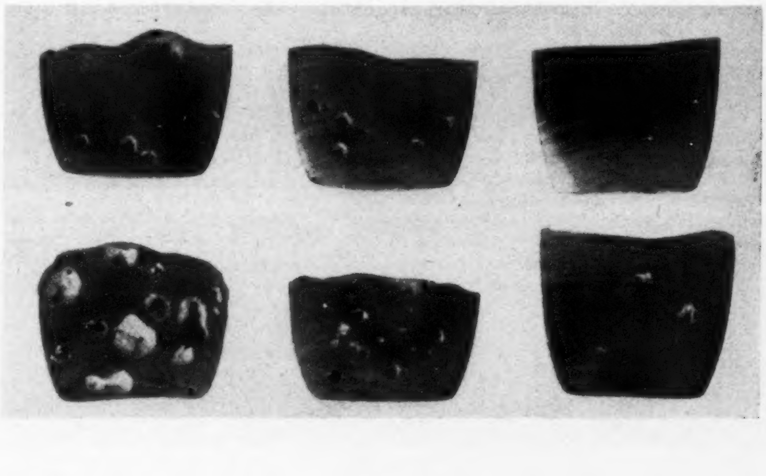
The diamond machining test has been described by the author[7] as a means of assessing the quality of automobile piston castings. It may, of course, be applied generally and in its simplest form, a sand cast D.T.D. test bar head is cut in half diametrically and the cut face is machined with a diamond tipped tool. The traverse is arranged so that each groove just misses the previous one. Set up correctly, this machining operation results in a mechanical macro-etch. The only requirement is a lathe capable of running at the high speed required without chatter.

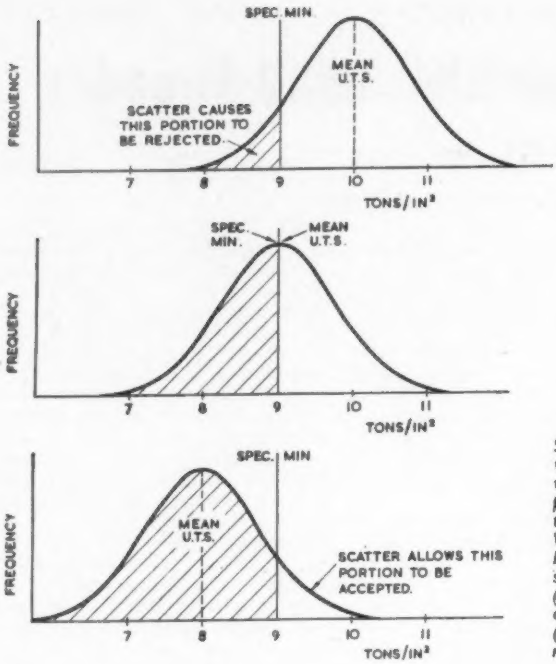
Diamond machined test bar heads may be used to control grain size without further chemical etching although chemical etching may be used to improve the contrast if required. It is important that for this type of test the D.T.D. bar is poured at the same temperature as the castings of the highest temperature attained by the melt (if that is the object of the test) and that the mould is filled as quickly as possible. It is quite satisfactory to stand the mould in a vertical position to fill it since the bar portion is not used for the tensile test.

This test has also been used to check the gas content of melts. Ruddle and Cibula[8] state that watching the gas bubbles liberated from a cast sample solidified at atmospheric pressure will indicate gas contents down to 0·6-0·8 cc/100 gm. and that this test is not sufficiently sensitive. There are no actual gas content measurements to confirm at what level porosity disappears from a diamond machined section but when a clear sample is obtained there should be no difficulty in obtaining both castings that meet radiographic requirements and test bar castings yielding properties that meet the minimum levels specified.

The reduced pressure test has been described in detail by Ruddle and Cibula[8] and has been frequently referred to in the literature. In its most practical form it is straightforward to operate and robust enough to withstand a normal foundry environment. It is certainly a sensitive indicator of the presence of traces of gas in a sample but such working conditions as the sample temperature, solidification time

Pairs of reduced pressure test samples at three levels of gas content. The difference in bubble size and distribution is due to variations in test conditions





Scatter about average values due to random variations in test bar preparation and testing conditions. Variation in average level due to such systematic causes as (a) variations in chemical composition (b) variations in metal treatment, etc.

and the pressure must be carefully standardized to obtain anything like reproducible results. Even so a given pore size can represent a wide range of gas contents.

Setting Up Reference Scales

Whenever control action must be taken on the results of visual tests, such as the assessment of porosity in a machine section, or of grain size or appearance of a fracture, it is desirable to set up reference scales so that continuity may be assured. It is a fact that in the absence of such a scale judgments vary. When things are running well there is a tendency to become lax, whereas a complaint from a customer will tighten the standards to, if anything, a higher level than before.

The usual procedure is to collect a fair number of specimens from the very worst to very best and then to arrange them in some sort of order of merit. The problem then is which to preserve and which to throw away; and also how many steps should there be on the scale?

To answer the second part first, the extremes are usually easy to define but invariably there is considerable scatter around the middle of the scale. This suggests that three steps — good, acceptable and reject—will normally be sufficient. Where the information required warrants an increase beyond three steps the scale can be expanded to five steps: good; acceptable; borderline; unacceptable; bad.

It will not normally be necessary to go beyond this, and seven steps will rarely be used.

Selecting representative samples to preserve as the reference points is best achieved by letting more than one person rate the samples in order of merit.

Each sample is assigned an order of merit as each operator places them in order, and the batch is then "shuffled" before the next observer makes his attempt. It is preferable that the observer's judgment should not be biased by watching the previous attempts.

The results may then be tabulated in the manner shown in Table I. Four observers, A, B, C and D, have rated 10 samples in order of merit (decreasing grain size, etc.).

TABLE I

Order of Merit	Observer			
	A	B	C	D
1	4	4	4	4
2	7	5	7	7
3	5	7	5	5
4	2	8	6	8
5	10	6	2	6
6	6	2	10	10
7	8	10	8	2
8	3	1	3	1
9	1	3	1	3
10	9	9	9	9

The sample numbers are entered in the Table and the scores evaluated.

At the top end of the scale, sample No. 4 has been rated 1 by all four observers. Sample No. 7 has been rated 2 by three observers and 3 by the fourth, and sample 5 has also been rated 3 by three observers and 2 by the fourth, so that sample 7 is suitable for position 2 and sample 5 for position 3.

The bottom end of the scale is less clear cut, apart from sample 9 that has qualified unanimously for the bottom of the scale. Samples Nos. 1 and 3 have each been rated 8 and 9 on two occasions each. Either sample may be taken and the ranks closed by eliminating one unnecessary place.

The remaining samples, 2, 6, 8 and 10, have been rated:

TABLE II

Rating	Sample No.			
	2	6	8	10
4	1	1	2	
5	1	2		1
6	1	1		2
7	1		2	1

Either sample No. 6 or 10 could be taken to represent the centre of the scale, since their ratings are the more consistent.

The scale, very much reduced in numbers, now stands:

TABLE III

Order of Merit	Sample No.
1	4
2	7
3	5
4	6 or 10
5	1 or 3
6	9

It now remains to relate this scale of, say, grain size or reduced pressure bubble test to tensile properties, and to fix an acceptance level.

The tensile test is, perhaps, the most misunderstood melt quality test, but it is also one of the most informative. It is, after all, a very cheap form of destructive test. The properties of the actual castings themselves could be obtained at considerable expense, and even then the results obtained by tensile survey nearly always underrate the performance of the component tested as a whole.

The interpretation of tensile test results has been dealt with in considerable detail by the author,[8] although it must be admitted that the methods described apply to foundries handling test results in fair numbers. The smaller foundry with little experience of this type of work has no quantity of data to process and, in the absence of control limits determined by past experience, the property levels called for in the various specifications must be accepted as criteria of quality and the frequency of test failures as an index of performance. Most specifications allow retests to be taken if the first test fails, and the frequency with which the retests pass or fail must be considered in relation to the frequency with which the first tests pass or fail. For example, the symptoms resulting in a high proportion of passes on first

test on the one hand, or in a high proportion of failures on retest on the other hand, are fairly obvious, but both have the merit that they indicate consistent conditions even if in the latter case they are consistently bad.

Failures on first test that are converted to passes on retest on an appreciable number of occasions indicate some inconsistency in the test bar preparation.

The proportion of failures, whether on first test or in total, will be controlled by the average level of properties and by the scatter. Consistent working conditions will minimize the scatter so that the average level may be established. It is then a matter of adjusting the working conditions so that the average level of U.T.S. values clears the specification minimum by a margin of preferably not less than 10-15 per cent. The margin for elongation values should be 30-80 per cent of the specified values.

Records providing evidence of consistent working conditions are far more convincing proof of ability than are records showing that the specifications have been met, but only at the expense of a considerable amount of retesting. In cases where considerable numbers of retests are involved, there is every justification for the attitude of mind that suggests that the castings accepted on a successful first test should also be retested to determine whether there was, in fact, any justification for accepting them.

This point can best be illustrated by an example. Assume that the average U.T.S. of an alloy required to meet a specified minimum of 9 tons/in^2 is 10 tons/in^2, and that under these conditions the scatter in properties is such that the proportion of successful first tests is 90 per cent. The scatter referred to is that due to variation in individual test pieces and to variations in the testing conditions. Ten per cent of the first tests will fail, but the chances that both retests will pass is high because the average level is satisfactory. The proportion will, in fact, be 81 per cent of the 10 per cent, so that 8·1 per cent may be added to the initial recovery of 90 per cent and the overall recovery is satisfactory and, of course, in those circumstances the retest procedure is quite justified.

If a change in the working conditions causes the average U.T.S. to fall, the proportion of successes on the first test will be reduced as a result. In fact, if the average fell to the specification minimum, the proportion of successful first tests would be 50 per cent. Under these conditions, the chances that both retests will pass is reduced to 25 per cent of the 50 per cent initial failures, so that 12·5 per cent may be added to the initial recovery of 50 per cent, making the total 62·5 per cent. The averages of the U.T.S. and elongation values indicate just how close to the minimum specified properties one is working.

To complete the illustration, the initial conditions are reversed by assuming that the average has deteriorated to a level 1 ton/in^2 below the specification minimum. Under these conditions, the scatter in individual test pieces and in testing conditions will cause 90 per cent of the first tests to fail, but will allow 10 per cent to pass. The chances that both retests will pass is 1 per cent of the 90 per cent failures, so that the overall recovery is 10·9 per cent. Under these conditions, the bulk of the material submitted for test will be rejected, and rightly so, because the average properties are below the minimum specified. Had retests been taken in the case of the 10 per cent initial successes, only 1 per cent of this 10 per cent would have survived, resulting in certain rejection of this unsatisfactory material.

Trend graphs showing the movement of the average properties in relation to the minimum specified properties are simple to prepare but more than repay the effort involved in their preparation.

References

4 A. V. Carless; *J. Inst. Met.*, 1957, **85**, 227.

5 E. F. Emley and P. A. Fisher; *J. Inst. Met.*, 1957, **85**, 236.

6 A. R. French; *J. Inst. Met.*, 1957, **85**, 293.

7 A. R. Martin; *J. Inst. Met.*, 1957, **85**, 209.

8 R. W. Ruddle and A. Cibula; *J. Inst. Met.*, 1957, **85**, 265.

Grain Boundary Strength

STUDIES were made by L. D. Kharitonova into the effect of various elements on the strength of the grain boundaries of aluminium-copper alloys at high temperatures. The composition of the alloying elements was as follows: (i) 1·86 per cent copper, (ii) 1·70 per cent copper, 0·50 per cent zinc, (iii) 1·71 per cent copper, 0·42 per cent manganese. Bicrystal specimens were subjected to load during testing, the boundaries of the specimens being disposed perpendicularly to the application of the load. The method used for producing these specimens and the experimental procedure are considered in detail in *Metallovedenie i Term. Obrab. Met.* It was established that zinc and manganese enrich the crystal boundaries of the solid solution of aluminium-copper-zinc and aluminium-copper-manganese. Zinc causes a decrease in the strength of the grain boundaries of aluminium-copper alloys, while manganese, in contrast, facilitates an increase in grain boundary strength at elevated temperatures.

Die-Casting Die Lubrication

A FULLY-AUTOMATIC air spray system for the application of the Vindie range of lubricants for pressure die-casting machines has been introduced by Isaac Bentley and Company Limited, Trafford Park, Manchester.

The "Vindie-Jaco" automatic spray equipment can be operated by the machine itself, or by hand or foot control, and will effectively spray on to the die faces the Vindie range of lubricants.

The unit consists of an atomizing unit which breaks up the lubricant into a fine mist and pipes it to a series of accelerator nozzles which convey it directly to any part of the die face. The spray heads will operate in a space as little as 1½ in. vertical height, which makes them suitable for many of the larger types of die-casting machine where space under the die slide is very restricted.

Advantages claimed for the system are: Improvement in casting surface finish; reduction in scrap castings; instant release of castings ensured; speed up in production; low initial installation cost per machine.

Vindie lubricants include "Vindie Z"—designed for use on zinc-base die-castings; "Vindie Y"—high class lubricant suitable for use on aluminium die-castings; and "Vindie X"—a graphited type lubricant suitable for application to aluminium castings where the surface finish required is of not such a high standard.

Other special types of die lubricants are available in the Vindie range for applications of an unusual nature.

The Vindie-Jaco spray system for lubricating pressure die-casting dies

Reviews of the Month

NEW BOOKS AND THEIR AUTHORS

PROCESS CONTROL

"Advances in Inspection Techniques as Aids to Process Control in Non-Ferrous Metals Production" *(Monograph and Report Series No. 24) Published by the Institute of Metals, 17 Belgrave Square, London, S.W.1. pp. 103, Price 30s. 0d.*

TEN Papers presented at a Symposium held on the occasion of the Golden Jubilee Spring Meeting of the Institute of Metals form the subject matter of this book. In view of the rapid development of techniques for process control and inspection, particularly during the last decade, as compared with the rule of thumb methods prevailing 50 years ago, it is particularly appropriate that so important a topic should have been discussed at this Jubilee Meeting. Whilst the Papers are representative of the newer techniques employed, there is some slight repetition where two contributions dealing with related topics have been presented, and the book would be more easily read had they been presented jointly, or alternatively, more thoroughly edited.

The first group of Papers deals in a clear manner with the measurement and control of strip thickness, and whilst it may seem odd in this setting that they should refer explicitly to the rolling of steel strip, most of what is said is equally applicable to the non-ferrous industries. Ultrasonic inspection, eddy current techniques and radiography are comprehensively and concisely dealt with, although the two Papers on each of these first two named topics do overlap to some extent. Of special interest is a Paper describing the determination of hydrogen content in aluminium alloys. since this topic has attracted considerable attention in recent years. Whilst an instrument for this purpose is well described, little, however, is said of practical difficulties encountered in its use under foundry conditions. The last Paper presented records experience gained in the use of three different types of self recording spectrometers for the analysis of copper and aluminium alloys. Development work carried out on the analysis of copper alloys with particular reference to copper itself is clearly described and it is indicated that the advantages which result from the elimination of scrap material, and other savings, offset the initial heavy capital outlay involved.

In general, it is not readily apparent whether a particular Paper is intended for the metallurgist, engineer or physicist, but this is not surprising since process control is no longer the province of any one specialist. Although it is impossible to give detailed coverage to the vast field of inspection techniques in ten Papers, the book does contain a wealth of practical information, essential theoretical background, and a very informative discussion.

H. J. S.

FOUNDRY TECHNOLOGY

"Introduction to Foundry Technology." *By D. C. Ekey and W. P. Winter. Published by McGraw-Hill Publishing Company Ltd., 95 Farringdon Street, London, E.C.4 and New York. Pp. xiii+296. Price 54s. 6d.*

THIS book is intended to introduce engineers to foundry techniques, and is divided in half. One section is devoted to lectures in outline, and the second to a summary of practical work intended to supplement the lecture material provided. This is an interesting and novel approach to foundry instruction, and has achieved a measure of success so far as adequate coverage is concerned. There are some errors, mainly of omission, and this is not surprising in any book based upon outline treatment only. The text is somewhat staccato in presentation, and in isolated cases the precise meaning is not clear, due to the wording employed; ". . . . production costs in large-lot sizes," and similar phrasing, is not helpful to English readers.

Some statements made are quite misleading; for example, "Castings produced in the die casting process are usually less defective, owing to increased casting soundness." "The actual casting procedure requires less skill," is surely untrue if the amount of scrap made in die-casting is any criterion. In some cases, over-simplification has rendered the information of little value as presented; the table used to convey the range of alloys used for non-ferrous castings is so condensed that the section dealing with aluminium, nickel and "manganese" bronzes reads, "nickel 16-25 per cent, zinc 2-20 per cent," and so on. The approximate pouring temperature ranges of all common foundry alloys are shown diagrammatically, but white irons should occupy the place given to grey cast irons, and the high tensile brasses should surely be placed below the aluminium bronzes so far as temperature requirements are concerned. There is much emphasis placed upon recent developments, and upon foundry mechanization; the essentially jobbing nature of the foundry industry could usefully be acknowledged.

Despite the defects discussed, this is a useful book in many respects; the section dealing with casting design is admirable, and the diagrams are also good. (It is regrettable that the well-known diagram on mould hardness, due to Buchanan, is credited to one of the staff of M.I.T.) There is an excellent bibliography, and this interesting book is good value for money.

J. B. McI.

FATIGUE

"Metal Fatigue." *Edited by J. A. Pope. Published by Chapman and Hall Ltd., 37 Essex Street, London, W.C.2. Pp. xiv+381. Price £3 10s. 0d.*

THIS account is written for engineers and almost exclusively by engineers. As such it does not do justice to modern concepts of the mechanisms of fatigue but perhaps this is not to be expected. However, nearly one half of the book is given the title "Fundamentals of Fatigue" and into its chapters go such topics as the effects of complex stresses, stress concentrations, residual stresses, cumulative damage (including statistical techniques) and corrosion fatigue, generally with reference to steels. Effects in steels are specifically discussed in chapters dealing with crack propagation and temperature effects.

In the next part, "The Fatigue Properties of Engineering Materials and Components" there are chapters dealing with high temperature alloys, aluminium alloys, cast irons, brasses, bronzes and bearing metals. Welded and mechanical joints obviously find a place here, but the inclusion at this point of two contributions dealing with fatigue in aircraft is a little difficult to understand.

Finally, in Part III, fatigue testing of engineering components is dealt with. The topics are reproducibility and the testing of bearings, welded structures and aircraft structures.

The editor and principal contributor, Professor J. A. Pope, had the engineering designer principally in mind when preparing this book and indeed when arranging the Nottingham conference at which the material was originally presented. If such men read and digest the information here presented we may confidently hope to be spared some of the accidents which can arise through faulty design. Metallurgists can profitably employ this book to revise their half-remembered knowledge of engineering when confronted with fatigue problems. It is difficult to imagine how such necessary and useful material could have otherwise been assembled and presented. The list of contributors is impressive but the authorship of each chapter is revealed only on the "Contents" pages. It is, therefore, amusing to look first at the chapters and pick out the characteristics of Frith, Forrest, Teed and Cox—to name only a few.

The book has no British rival and can be recommended to all practical men who have to deal with fatigue problems.

T. B.

Finishing Supplement

Treatment of Precious Metals

AT the first Technical Session of the Annual Conference of the Institute of Metal Finishing, held at Brighton in April, the second of the two subjects under consideration was "Treatment of Precious Metals." With Dr. T. P. Hoar in the chair, the Papers were presented and discussed individually. Abstracts of the Papers and the main items from the discussion which ensued are published here.

Electroless Palladium Plating

By R. N. RHODA, Ph.D.

DEPOSITION of palladium by chemical reduction on catalytic surfaces has been carried out using a palladium amine complex, a reducer, and a stabilizing agent. Most metal surfaces are effective catalysts in the reaction, and the deposit is also catalytic, so thick coatings can be deposited. Rate of deposition is determined by the concentration of the palladium, the temperature, and the concentration of the hydrazine. Operating conditions are: palladium (complexed) 0·03-0·2 m/L, amine 7-10 m/L, hydrazine 0·005-0·01 m/L, stabilizer 0·01-0·1 m/L, temperature 30°-70°C.

The palladium deposit was of at least 99·4 per cent purity, with a density of 11·96 gm/c.c. Hardness is to some extent dependent on rate of deposition, the higher rates producing the softer and more ductile deposits. Deposits up to 0·0025 in. have been plated, but thicker deposits could be effected. Variations of the technique permit deposition on carbon, graphite, glass and plastics.

(*Trans. Inst. Met. Finishing,* 1959, **36,** 82).

DISCUSSION

D. E. Weimer (M. L. Alkan Ltd.) asked whether the reaction could be controlled through the gaseous products which were obtained, and on what basis metals the palladium could be put.

Other questions put to the author were whether the process was subject to licensing arrangements or protected by patents, or whether anyone could "have a go," and whether some idea could be given of the adhesion of the plating on the basis metal and whether there was any trouble if a particular type of barrel was not used.

Dr. T. P. Hoar asked whether it would still be possible to plate palladium if the hydrazine was put in one pot and the palladium in the other and the electrodes connected.

Dr. Rhoda, in reply, said they did not know whether or not the gaseous products obtained could be used to control the reaction, but they had started a few experiments to find out whether that would be possible. This work on palladium was quite new, having been started only two and a half years ago, and they were just getting to the stage where they could do it day after day and get the right answers.

The next question concerned the metals which could be plated. They had been able to put this palladium on all metals except copper and copper-base alloys. They used ammonium hydroxide as the solvent, and it was a terrific cleaner for the copper and copper-base alloys, so that so far it had not been possible to put palladium on them unless a layer of gold or some other material was put in between. The only trouble with any metal had been in the cleaning of the metal; when that could be done there was no trouble.

The process had been patented, but they had not worked out any of the details. This would eventually be dealt with through the International Nickel Company in the U.S.A., but at present it was too new to be able to say exactly how the commercial aspects would be handled.

So far as snags in the process were concerned, the only one about which they wanted to do something was that they were working with 50 per cent ammonium hydroxide solutions, which meant working under a hood. The whole barrel had to be in a hood. They would like to reduce the ammonium hydroxide concentration, but that was the only point that bothered them. Most of the original work had been done on platinum metals, but they had then gone on to nickel, and the Paper mentioned a large number of metals on which it was possible to put the platinum, if they could be cleaned. So far as the non-metallic materials were concerned, one could take a non-metallic material and sensitize it and put the palladium on by this process, so that it sometimes happened that if the process was done in a non-metallic container one would start coating a palladium deposit on the inside of the test tube, and if there were chips and cracks this could happen, but if the apparatus was kept clean before starting the process there would be no trouble.

Not much work had been done on the advantages and disadvantages of this palladium process compared with electrodeposited palladium. They had always felt that with electrodeposited palladium it was possible to get a hydrolytic product which was subject to blistering. That kind of trouble was not experienced with the new procedure.

Some Observations on Silver Anodes

By R. R. BENHAM, A.R.I.C.

TROUBLES experienced with the shedding or flaking of silver anodes gave rise to a series of investigations into the effect of grain size, anode current density, and the presence of impurities on the behaviour and appearance of anodes. The results confirmed that silver anodes should be of high purity. They further suggested the following: an annealed anode will give better performance than a work-hardened anode. Flaking is reduced in incidence by increasing the anode current density. Flaking is more prone to occur in high-speed solutions, i.e. those of high concentration used at elevated temperatures. Organic contamination in the solution, such as may be caused by unsuitable tank linings, can lead to a serious risk of flaking with a large-grain anode, and a lesser risk with a small-grain anode. Although large-grain anodes are satisfactory in the conditions employed by many electroplaters, a pure, annealed anode with small, regular, equi-axed grains is capable of giving good results over a wider range of conditions.

(*Trans. Inst. Met. Finishing,* 1958, **36,** 22).

DISCUSSION

T. van der Klis (K.L.M., Holland) stated that in their silver plating line they had recently found bad dissolution properties of some of the silver anodes. The result was that large amounts of silver were found in the form of grains or clusters in the anode bags. Only a few anodes gave this trouble; 95 per cent of them dissolved in the desired way at the same time that the others became rough.

D. E. Weimer mentioned that when investigating a new bright silver solution some three years ago they had met with considerable difficulties with respect to anode corrosion and in the first instance had been inclined to blame the solution for this, but laboratory investigations had shown that the solution was not responsible and that by changing the type of anode entirely different dissolution characteristics were obtained. Could the author be more specific about the nature of the organic materials which were likely to be harmful to the dissolution of silver anodes? Did he consider that rubber linings were generally unsatisfactory for silver plating vats, and what alternative materials did he recommend?

R. R. Benham replied that Mr. van der Klis had let him have some samples of the anodes in question, and he did not think it was the same phenomenon; on the one side it was perfectly smooth and on the other very nodular. It seemed to be a case of bad anode connection and action as a bipolar electrode.

The President suggested that that did not account for the grains or cluster in the bags.

R. R. Benham, dealing with Mr. Weimer's point, said he did not consider that rubber linings were generally unsatisfactory, but they were probably generally suspect and should be closely examined before setting one up for silver, and laboratory trials carried out. Some had been satisfactory and others harmful. He used plain mild steel without any lining other than glass linings, which seemed all right for the conventional cyanide electrolyte. In other cases a rubber or plastics lining might be essential, and there the hard p.v.c. should be satisfactory.

J. M. Sprague said he attached some importance to the question raised by Mr. Weimer of the actual materials which caused trouble. Some work had been done on accelerators and other constituents of rubber which were known to cause difficulties in plating, and it would be helpful if the author could tie the matter down more than was done in the Paper. When all the information was added up it might be possible to be more precise about the type of lining to use.

In assessing the results using anodes of different grain size the author relied on the appearance of the anode. It might be difficult to measure the size of the flakes, but could not something useful be done in that way? They were accustomed to think of flakes or particles of metal coming out of an anode as a result of dissolution round the boundary grains. If the dimensions of the flakes produced could be determined it might be possible to relate them more precisely to the grain size which was being determined.

R. R. Benham said he had little to add to that. He agreed that it would be helpful to know what materials were responsible for the difficulty, but the work had not been carried out so far as that.

The President remarked that if the author could solve this difficulty silver would probably have a long way to go.

Some Experimental Observations on the Effect of Addition Agents on Stress and Cracking in Rhodium Deposits

By F. H. REID, B.Sc., A.R.I.C.

PRELIMINARY results are described of two approaches to the problem of producing crack-free rhodium deposits by modification of a conventional type of electrolyte, either of which might provide a useful basis for new formulations. In the case of additions of aluminium or magnesium sulphate, stress remains tensile and cracking is to be expected as deposit thickness is increased. With selenic acid additions, however, the initial tensile stress is reversed sooner or later, depending on the sulphuric acid concentration, and cracks formed initially tend to close up with increasing thickness until a deposit is produced which may be regarded as virtually crack-free from the corrosion protection viewpoint.

The relative protective values of deposits from conventional and selenic-acid-modified electrolytes were demonstrated by plating copper rods with 0·0005 in. of rhodium from each type of solution and immersing in concentrated nitric acid. After 25 min. the specimen from the unmodified solution was completely dissolved, whilst the other remained unaffected.

The selenic acid type of solution has advantages over aluminium- or magnesium-containing solutions in respect of the brightness of deposits even at considerable thicknesses (up to 0·002 in.) and there are indications that the former type of electrolyte will be resistant to the raising of stress by contamination.

Additions of copper at a concentration of 1 gm/L enhanced the stress in deposits from aluminium- and magnesium-containing electrolytes, but had no marked effect on the stress variation in deposits from electrolytes containing selenic acid.

(*Trans. Inst. Met. Finishing*, 1959, **36**, 74).

DISCUSSION

S. B. Gane (Johnson, Matthey and Co. Ltd., Birmingham) said that in many industrial applications low resistivity was an important factor. Assuming a figure of 4·9 micro/ohm/cm. at 20°C. for pure rhodium, to what figure would this rise in a deposit containing 10 per cent selenium? Would the reduced hardness obtained by the addition of selenic acid seriously affect the life of components such as sliding contacts? The nitric acid test carried out on deposits from the normal rhodium solution and from this solution plus selenic acid showed the absence of cracks in the latter, but was it possible that corrosion could occur in the rhodium-selenium deposit over a period of time?

S. C. Barnes (University of Birmingham) said that in his introduction the author stated that the interfacial region between the cathode surface and the electrolyte might be regarded as a region of abnormally high energy, particularly when the deposition reaction involved a high activation overpotential. That was true, but these high overpotentials were a prerequisite for the reaction to proceed at the rate determined by the applied current density. It was difficult to see how high overpotentials could promote the formation of metastable structures unless the formation of such structures was associated with a lower activation energy than that for the stable, room-temperature form.

The author mentioned that solid state physics and modern theories of metals, for example the dislocation theory, should enable useful advances to be made in the understanding of electrolytic crystal growth. Mr. Barnes agreed, but pointed out that the direct application of modern solid state theory was by no means easy. For example, the spiral mechanism which had been suggested as an explanation of crystal growth at low supersaturations rarely applied during practical plating. At normal current densities the overpotentials associated with growth were equivalent to fairly substantial supersaturations, so that nucleation should be no problem. Surfaces were seldom if ever smooth and sufficient deposition sites were always available at kinks and steps and at impurity sites.

The interpretation of certain types of stress in terms of dislocation arrays was probably correct. It had recently been suggested that the incorporation of impurities into a growing crystal was accompanied by the formation of dislocations. Pick and Wilcock had shown that copper deposits grew by the merging of crystallites or platelets. If adjacent platelets met with a misorientation of only a few minutes it was quite possible that the dislocation network was produced to accommodate this misfit. If by either of those mechanisms more edge dislocations of one kind were produced then, if the deposit was constrained, an internal stress would result.

Dislocation theory was also useful when an attempt was made to interpret the observation that incorporation of impurity was usually accompanied by a fall in ductility.

The author stated that modern theories of the solid state were very valuable tools to the research worker in electrodeposition. The production of dislocations during electrolytic growth was worth extensive study not only for fundamental reasons but because it would aid future workers in their search for new and better solutions. Given sufficient theory, it should be possible to design specific solutions for particular deposit characteristics and so avoid the painstaking empirical approach so long practised.

D. E. Weimer (M. L. Alkan Ltd.) expressed great interest in the measurement of stress in rhodium deposits and said he was interested to learn of the results obtained when using different basis metals. It would seem from the author's work that the stress of the deposit, based on the initial slopes of the deflexion/time curves, was dependent on the base metal. Had the author repeated some of his earlier stress measurements using silver as a basis metal?

Table I and Fig. 2 showed the effect of aluminium and magnesium additions on the stress in rhodium deposits. Had the author any quantitative stress measurements for deposits plated from selenic-acid-containing solutions? The author referred mainly to a 10 gm/L rhodium bath in conjunction with additions of selenic acid, although many operators used solutions containing 4-5 gm/L of rhodium and much of the author's own early work had been carried out in such solutions. Was this because solutions containing higher rhodium gave less stress, or because the selenic acid

additions were effective only at the higher rhodium metal concentrations?

Author's Reply

F. H. Reid, in reply, said he could not give the figure for resistivity for which Mr. Gane asked, but he guessed that it would be higher than for conventional rhodium. The effect of reduced hardness on sliding contacts was an interesting point. Some people maintained that rhodium of 800-900 D.P.N. hardness was too hard in many applications. It was often used with a soft wiper, and the rate of wear of the wiper was extremely high. For many purposes one could afford to lose some of the hardness in rhodium and still get quite an effective surface They had had results from their physics department which showed that wiping gold against rhodium, if the rhodium was 0·0001 in. thick there would be no wear on it at normal pressures and the gold would just wear away, so that the hardness figure for the rhodium could drop to 600 and it would still have a useful hardness for practical purposes.

Comments had been made on the nitric acid test and the question raised of whether or not it showed absence of cracks or corrosion with time. To begin with they thought that they had a genuine crack-free deposit, but they had come to the conclusion that the network of cracks took longer to develop. They were not sure whether or not corrosion took place. A faint pattern might be found on a deposit on repeating the test after a few weeks when originally it had shown none. The corrosion might have penetrated right through the base metal or it might be a surface effect.

In reply to Dr. Barnes, they had found the effect of inclusions on ductility was most marked. The brittleness was extreme; one could take them off, but the moment one touched them they tended to break up. This might be due to the selenium which was dispersed in the deposit.

Electrodeposition of Platinum from Chloroplatinic Acid

By RALPH H. ATKINSON

THE electrodeposition of platinum from aqueous solutions containing chloroplatinic acid (15 to 25 gm/L) and hydrochloric acid (10-390 gm/L HCl) has been investigated at rates of deposition from about 0·1 to $1{\cdot}1\times10^{-3}$ in/hr. and at temperatures from 45° to 75°C. in a successful attempt to define the conditions for the production of ductile plates. The quality of the plates was assessed by micro-examination, by their hardness, and by a simple rolling test. The process was operated with platinum anodes, which behaved as soluble anodes in all electrolytes which were acid enough to yield ductile deposits. The plating cell was operated both with and without a diaphragm; the non-diaphragm cell was preferred because it was simpler to operate. The amount of stirring was critical; best results were obtained without any stirring except that provided by the thermal convection currents when the bath was at 60°-70°C. Plating conditions could not be defined in terms of current density because the plating rate was affected by other important variables. For the production of ductile deposits (hardness 155-250 KHN) there appeared to be a minimum rate of deposition which varied with the acidity of the bath, namely from $0{\cdot}7\times10^{-3}$ in/hr. at 225 gm/L HCl to $0{\cdot}35\times10^{-3}$ in/hr. at 290 gm/L HCl. Below these minima the deposits were harder (250-350 KHN) and were either cracked as plated or they cracked on rolling; as the rates of deposition were increased above these minima the deposits remained ductile up to the rate (about $1{\cdot}0\times10^{-3}$ in/hr. regardless of acidity) at which they became rough, spongy or semi-burnt. No fully ductile deposits were obtained at acidities below about 220 gm/L HCl. The electrolyte was found to have a smoothing effect at appropriate rates of deposition; smooth deposits up to 0·013 in. thick were obtained. Heating the electrodeposits above 1,100°F. caused blistering which was attributed to the presence of occluded platinum compounds. The hydrolysis *p*H of chloroplatinic acid, which was measured for the first time, was found to be about *p*H 2·2. An explanation is proposed for the unusual relationship between rate of deposition, acidity of bath and quality of deposit. On account of its unusually high acid content, the plating solution is only suitable for the deposition of platinum on noble metals.

(*Trans. Inst. Met. Finishing*, 1958, **36**, 7).

DISCUSSION

Dr. T. P. Hoar said that the deposition described took place from a strongly acid solution. Was it possible to use it to plate only those materials which were not sensitive to strong hydrochloric acid?

Dr. Rhoda replied that the disadvantage of the process—which was patented, but which he was not sure was going to be used with any but the platinum metals—was that almost all the metals were dissolved in the electrolyte, so that it was not possible to plate out on many materials other than the platinum metals. They intended to try the flash coating of gold to see if that could hold up long enough to enable the process to be used. Just before coming to this country he had seen an account of work done some years ago on the lines described in the Paper, but using a lower hydrochloric acid concentration and a higher concentration of metal chlorides, and it might be worth while to try this. It would be helpful to lower the acidity of the bath.

The Conference then adjourned until the following day.

Men and Metals

Information has reached the Royal Society to the effect that **Dr. Louis Essen,** a Senior Principal Scientific Officer at the National Physical Laboratory, Teddington, has been awarded the A. S. Popov's Gold Medal by the Academy of Sciences of the U.S.S.R. This award is for the most distinguished scientific work in the field of radio-engineering performed during the period from 1956 to 1958. The work of scientists from all countries is considered, but this is the first time that it has been awarded to a scientist outside the Soviet Union. Dr. Essen was educated at the University of Nottingham, and joined the scientific staff of the National Physical Laboratory in 1929.

At the annual general meeting of the Birmingham Metallurgical Society, being held to-day, it will be announced that the President for the ensuing year is to be **Mr. S. G. Temple,** M.Sc., F.I.M. The elected vice-presidents are: **Mr. L. G. Beresford,** B.Sc., F.I.M.; **Mr. P. F. Hancock,** B.Sc., F.I.M.; **Mr. S. Heslop,** A.I.M., and **Dr. I. G. Slater,** M.Sc., F.I.M. Members elected to the Council are **Dr. W. O. Alexander,** B.Sc., F.I.M.; **Mr. S. S. Chatwin, Mr. A. G. Haynes,** B.Sc., and **Mr. W. L. Stanton.**

It has been announced by Birlec-Efco (Melting) Limited that **Mr. D. N. Gifford,** commercial manager, has been appointed a director of the company.

Appointed deputy chairman of the United Steel Companies, **Mr. A. J. Peech** will continue in the office of general managing director.

Formerly sales manager of Sciaky Electric Welding Machines Ltd., **Mr. Charles A. Burton** is joining the A.R.O. Machinery Company Limited next month to take over new projects and developments.

Appointed President of the Electrical Development Association for the year 1959-60, **Sir Josiah Eccles,** C.B.E., M.M., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., is deputy chairman of the Electricity Council.

News from Colloidal Graphite Limited is that **Mr. Alan A. Simons,** B.Sc., has taken over the responsibilities for production and sales of all products of the company.

In succession to **Mr. J. W. Haig Ferguson,** M.A., A.M.I.Mech.E., A.M.I.E.E., who has been promoted divisional director, **Mr. F. Duerden,** B.Sc., A.M.I.E.E., has been appointed manager of the Electronics Department of Bruce Peebles and Company Limited. Mr. Duerden took his degree at Manchester University and started his professional career with the Research and Development Department of the Marconi Wireless Telegraph Company.

IMPROVING PRODUCTIVITY WITH HIGHER QUALITY AND GREATER ECONOMY

Modern Melting of Non-Ferrous Alloys

By F. M. BUNBURY, B.Sc. and S. J. ROGERS

(*Concluded from* METAL INDUSTRY, 22 *May*, 1959)

WHILE the control of hydrogen content is an essential feature of melting all non-ferrous alloys, both copper- and aluminium-based, some additional treatments, applicable only to individual types, are desirable to develop their maximum properties.

Deoxidation of Copper-based Alloys. The oxidation/deoxidation technique of melting many copper-based alloys has already been mentioned in the discussion on control of hydrogen content; by this technique, the alloy is melted under strongly oxidizing conditions to raise the oxygen content of the liquid metal so that the hydrogen content is suppressed to below its solid solubility in the alloy. In modern melting, these oxidizing conditions are usually maintained by means of oxidizing fluxes. Naturally before pouring, it is essential to remove all this oxygen, which is present in the melt as metallic oxides, for two reasons; over-oxidized metal produces castings of low physical properties and, during cooling, encourages the "steam reaction" which is the most serious cause of gas porosity in copper-base alloys. The reaction involved is essentially—

$$Cu_2O + H \rightleftarrows 2Cu + H_2O$$

During cooling and solidification the reaction favours the formation of copper and water vapour; the latter is completely insoluble in copper alloys and is the principal cause of gas unsoundness. Thus, porosity in copper-base alloys (Fig. 2) can result from either hydrogen alone or from the combined action of hydrogen and cuprous oxide.

The main requirements of a deoxidizer for copper-base alloys are:

(a) The free energy of oxide formation must be greater than that of the constituent metals of the alloy, but the oxide formation should not be too violent for safety reasons.

(b) The products of the deoxidation should preferably separate from the melt to form a fluid slag or, alternatively, remain innocuous in the metal.

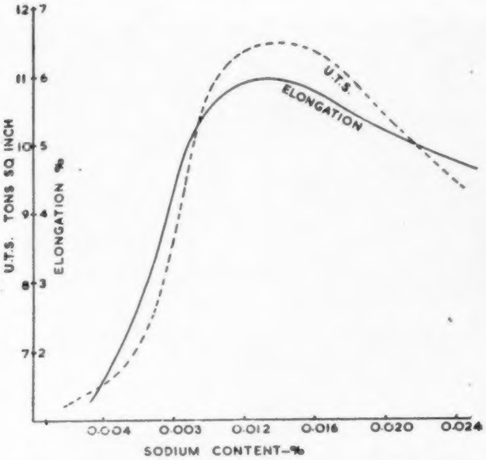
(c) Excess of deoxidizer should have no detrimental influence on the properties of the cast metal and should preferably protect the molten metal from oxidation during pouring.

The most widely used material for copper-base alloys is phosphorus, which forms a liquid deoxidation product which floats to the surface. In most alloys an excess of phosphorus has no detrimental influence if it is maintained within moderate limits but, in pure copper, it greatly reduces electrical and thermal conductivity, and in some tin bronzes an excess can influence the severity of metal/mould reaction. Calcium, as calcium boride, is frequently used as a deoxidant for high conductivity copper alloys, but its efficiency is not as great as that of phosphorus and it is more expensive. Neu[14] in an investigation into the efficiency of various fluxing and deoxidation treatments of pure copper described a simple technique whereby the oxygen content is first reduced by phosphorus, added in modest amounts to the point where no residual phosphorus exists in the melt, and then by calcium boride to complete the deoxidation treatment. Other materials which have been used to deoxidize copper-base alloys are magnesium, lithium, manganese boride and silicon. Some of these are effective and have special applications in certain alloys where the presence of phosphorus is undesirable or where they perform some additional function such as the "fixing" of sulphur in copper/nickel alloys by magnesium or the removal of hydrogen from copper/nickel alloys by lithium.

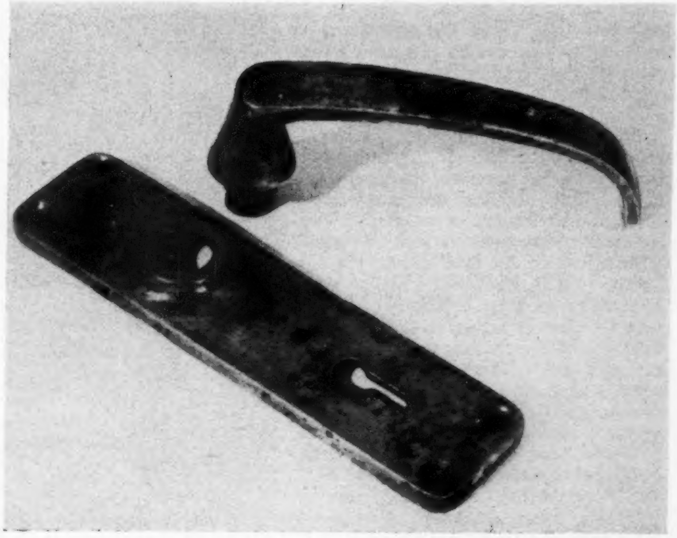
Grain Refinement of Light Alloys. The beneficial effect of a fine grain structure on the mechanical properties and feeding characteristics of light alloys has been widely appreciated. Cibula[15] in a very extensive study of grain refinement of aluminium alloys produced strong evidence to show that grain refinement is due to the nucleation of aluminium by solid particles. In such alloys refinement is generally achieved by the introduction of titanium, boron or zirconium, which are added to the melt either as hardener alloys or as proprietary chemical compounds usually in tableted form. Combined additions of titanium and boron lead to considerably greater refinement than single additions of either element alone. This is probably due to the fact that titanium boride is an effective nucleating agent in addition to the nuclei resulting if these elements are added individually, namely, aluminium boride and titanium carbide. Additionally, this combined treatment leads to greater grain stability on remelting which has been found to be effective in minimizing grain growth defects experienced in the wrought metal industry.

Modification. It is well known that the introduction of a very small amount of sodium into aluminium alloys containing from about 8 to 14 per cent of silicon effects a very marked improvement in the mechanical properties, principally in ductility; the process by which sodium is introduced and the alloy structure improved is known as modification. The unmodified alloy structure consists of plates and coarse needles of silicon in a matrix of aluminium-rich solid solution, but after the introduction of sodium the structure is changed to one of aluminium-rich solid solution in a matrix of fine aluminium solid solution/silicon eutectic. The desirable residual sodium content in such an alloy is about 0·01 per cent but subsequent melting or degassing treatments of the alloy usually

Fig. 2—Typical example of gas unsoundness in a 4 in. diam. copper-base alloy casting



Above : Fig. 3—Effect of increasing sodium content on physical properties of LM.6 alloy



Right : Fig. 4—Staining on acid-tested brass castings due to trapped alumina films

remove much of this sodium and consequently the treatment is necessary each time a melt of the alloy is prepared. Ever since the process was discovered by Pacz,[16] sodium has been added either in its pure metallic state or as fusible sodium salts; both methods have their advantages and disadvantages. Pure sodium metal is usually supplied in an oil medium which is so difficult to remove entirely that it becomes a source of gas, while fusible sodium salts attack crucibles to a marked degree and may require a high metal temperature for sodium pick-up to be effective; both techniques are very ineffective as regards efficiency of sodium pick-up. Consequently, founders of such alloys can inadvertently add either too little or too much sodium. Morrell[17] has shown that the optimum sodium content of LM.6 alloy is between 0·01 and 0·015 per cent. If the sodium content is too high, the alloy is over-modified and there is a marked fall-off in physical properties (see Fig. 3).

Recently vacuum processed sodium packed in hermetically-sealed aluminium canisters has become commercially available; sodium packed in this manner contains none of the oil or dissolved hydrogen which is present in common commercial sodium and, furthermore, the aluminium canister protects the sodium from fusing or vaporizing before it can be effectively plunged below the metal surface. The efficiency of sodium pick-up by the use of material packed in this manner is increased to almost double that of ordinary commercial sodium and four times that of sodium salts. To achieve an accurate residual sodium content consistently from melt to melt, the accepted current practice is to degas the metal before modification in order to remove any existing sodium which may be present and then to introduce a known amount of sodium packed as described.

Control of Impurities. The presence of metallic or non-metallic impurities in a casting is often not detected until the product fails in service or has, at least, reached an advanced stage of polishing or machining. It is unfortunate that the foundryman cannot detect small amounts of metallic impurities in his molten metal by any practicable means available to him but he can adopt techniques to avoid contamination as much as possible; careful selection of his furnace charges, the selection of fluxes containing no undesirable elements, the "washing" of the metal with fluid fluxes and the coating of iron tools with refractory preparations are some of these.

In many copper-base alloys the presence of very small quantities of silicon or aluminium can ruin a melt and the castings poured from it. These elements oxidize readily and their oxides remain suspended in the melt and ultimately appear as inclusions in the solidified casting. The results are well known to any non-ferrous founder; aluminium oxide inclusions ruin the pressure tightness of gunmetal valves and, in the highly competitive field of brightly polished or electroplated castings, non-metallic inclusions are one of the most serious causes of scrapped components (see Fig. 4). Naturally, these elements are not present in ingot purchased from a reputable source but, if the foundryman is melting scrap, their presence may be unavoidable. Fortunately, chemical preparations are available for the removal of many of them and these can easily be applied by plunging and stirring into the molten metal. In aluminium alloys, oxides of the parent metal itself are often present (see Fig. 5) but these can be effectively removed before pouring the metal by washing with a liquid flux generally consisting of low melting point chlorides. In the cupro-nickel alloys, sulphur has a deleterious effect on physical properties but it can be eliminated by the addition of magnesium to the melt and, in a similar manner, manganese is sometimes added to magnesium and aluminium-silicon alloys to render harmless the effect of iron contamination; manganese combines with the iron to transform it from a needle-like constituent to one of isolated globular form.

Melt Quality Tests

Until relatively recent times the non-ferrous foundryman was in the unfortunate position of not having the means whereby he could assess the quality of a charge of molten metal. Consequently, it was not until the melt had been transformed into castings, often in an advanced stage of machining, that deficiencies such as widespread porosity due to evolved gas were revealed. The light alloy founder now has reliable means of checking the gas content of his metal before it is poured, but with the copper-base founder, conditions are not quite so favourable. This problem is at present under investigation by a technical sub-committee of the Institute of British Foundrymen which, in an interim report,[18] makes it clear that serious attempts are being made to find effective ways to assess melt quality, especially as to gas content.

For aluminium alloys the Straube-Pfeiffer reduced pressure test has recently been modified and made commercially available as a portable instrument, as described by Watson and Hawthorne.[19] The test is a simple and very rapid one; a small sample is ladled from the furnace and poured into a steel cup which is placed under a bell-jar from which air is then evacuated. The solid test casting is then merely visually inspected whereby, with experience, an operator can immediately assess the gas content of the melt by the appearance of the degree of "mushrooming" on the surface of the sample. Another valuable instrument has recently been invented[20] which,

after suitable calibration, is capable of indicating the actual gas content of a melt. This instrument operates on the principle of establishing equilibrium conditions between the hydrogen content of the melt and the quantity of hydrogen picked up by passing a stream of nitrogen continuously through the liquid metal via the instrument. The nitrogen gas is pumped through a concentric ceramic tube into the melt and returns through the outer channel which has a Katharometer in circuit. An electrical circuit subsequently records hydrogen content directly from variations in thermal conductivity of the hydrogen-contaminated nitrogen gas. This ingenious instrument is most efficient but is rather more fragile and requires a more skilled operator than the modified Pfeiffer test. It would be most desirable if either or both of these instruments could be used with copper-base alloys and this is receiving much attention at present; Cooksey[21] has described modifications to the portable reduced pressure instrument and Moore[22] developed a means of utilizing such apparatus for gas detection in copper-base alloys by first changing the solidification characteristics of the test sample; an addition of tin is made to the sample, ladled from the parent melt, to reduce the solidification range of the alloy and so to accelerate the formation of a solid skin over the surface to prevent the escape of gas while the sample is solidifying (Fig. 6).

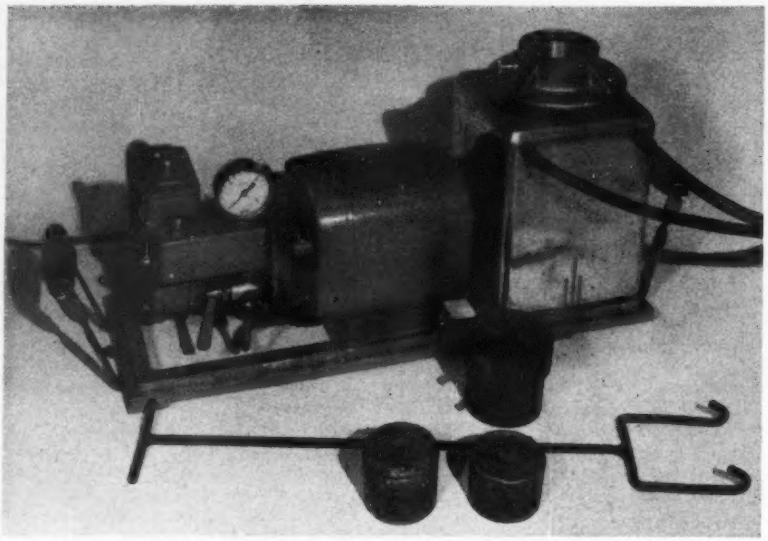


Fig. 6—Portable reduced pressure testing apparatus adapted for use with copper-base alloys

In the deoxidation of alloys such as gunmetal, bronze and high conductivity copper the foundryman very often adopts methods similar to the test described by Neu[14] whereby the degree of deoxidation is visually assessed by the appearance of the surface shrinkage pipe at the top of a test sample. The technique is a simple and rapid one, and is most acceptable because it is applicable to the molten melt before pouring. A small test bar is poured and its shrinkage characteristics observed; if it solidifies with a mushroomed or flat head, deoxidation is insufficient and more deoxidants are added until the sample solidifies with a definite shrinkage pipe.

Some producers of ingot, billets, slabs and castings melt very large quantities of metal at a time and rapid confirmation of the composition of an alloy, while it is still in the furnace, would be most desirable but, unfortunately, the means of achieving this is only open to relatively few firms which can afford the extremely expensive equipment. Such instruments are available, but require skilful operators and function on the principle of photometrically measuring the spectra emitted from an electric arc passing between a small sample of the metal and an electrode of known composition; they are capable of producing a complete chemical analysis within minutes of drawing a sample from the furnace. Spectrographic chemical analysis has advanced so spectacularly in recent years, that it is possible that such equipment may become economically available to the smaller foundry within the foreseeable future.

Fig. 5—Typical inclusion defect in light alloy casting (bottom left)

Conclusion

In the melting of non-ferrous alloys there is at present more and more emphasis on quality control and undoubtedly a considerable amount of research is being devoted to methods for improving melt quality as well as practical methods for checking it. It is along these lines that the foundryman can expect to see the greatest advancements within the next few years.

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Industrial News

Home and Overseas

At the Foundry Exhibition

Not included in our review of the British Foundry Exhibition, which has been held at the Bingley Hall, Birmingham, during the last ten days, were the exhibits of two firms whose details reached us too late for last week's issue of this journal. **Luke and Spencer Ltd.,** of Altrincham, have been showing five of their machines, the largest being a 30 in. double-ended high speed grinding machine which is stated to be ideal for grinding heavy iron and steel castings. They were also exhibiting a 20 in. and 24 in. machine which are similar in design and suitable for grinding rather smaller castings.

Then they also had on view a smaller machine carrying 16 in. diameter wheels suitable for foundries which produce small iron and non-ferrous castings, and fitted with wheel guards developed by the British Cast Iron Research Association. This company, of course, produces a complete range of abrasive wheels for use in foundries, although these were not exhibited.

For the first time, **Ridsdale and Company Limited,** of Middlesbrough, exhibited their foundry sand testing equipment with a "New Look." This is a high gloss hammered-grey stove enamel finish which is both serviceable and readily cleaned. A comprehensive range of Ridsdale-Dietert equipment was shown for testing the properties of moulding and core sands, including accessories for preparing specimens in shell moulding and CO_2 sand mixes

Of special interest on this company's stand was the completely new Dietert-designed universal sand strength machine, which was also being shown for the first time in this country. This machine is stated to have much higher capacities than the old style machine. It can test compression strength up to 520 lb/in^2, tensile up to 620 lb/in^2, and transverse up to 370 lb/in^2. A special feature of this motor driven dead-weight machine is its excellent sensitivity at the low ranges, as there are three separate scales for compression and two ranges for the other tests. Another point of interest is that most of the accessories designed for the old style machine can economically be adapted for use on the new machine.

Expansion in Australia

New factory buildings were opened last month at Ballarat for Simmonds Aerocessories Pty. Ltd., the Australian subsidiary of **Simmonds Aerocessories Ltd.,** a member of the Firth Cleveland Group. The new buildings include a main office building and a temporary area which will be used later for the extension of offices. A further extension is to be built to link the new buildings with the old.

Aluminium Alloy Grain Carriers

A new type of grain carrier built for British Road Services has a chassis frame of channel and angle sections in Noral B51 SWO aluminium alloy. Two main channel members extend the full length of the body and are braced by three full-width cross-members of the same section at the front, and by four similar cross-members at the rear, leaving a clear opening of 12 ft. in the centre of the frame. Longitudinal members at the rear accept the semi-trailer bogey. All the above members are assembled with cadmium-plated high tensile steel fitted bolts and gusseted with aluminium alloy plates.

The body, which is 24 ft. 6 in. long by 7 ft. 1½ in. wide, is constructed from Noral B51 SWP aluminium alloy sections, Noral M57S½H aluminium alloy sheet, and Noral B51 SWP plate. All the aluminium alloys were supplied by the **Northern Aluminium Company Ltd.**

Light Metals in Ireland

It is reported from Dublin that a light metal factory is to be set up in Kinsale, County Cork, and its production will include motor car radiators and light agricultural machinery. Last week a 5½-acre site in the town was purchased by a German, Herr Harold H. Graepel, of Oldenburg.

Site levelling work is to be started immediately. It was learned that the firm responsible intends to train local workers in Germany. It is understood that plans to establish the factory in South America met with difficulties because of the uncertain raw materials supply position there.

Metal Cleaning Equipment

A completely new range of standard industrial spray washing equipment has just been introduced by the **Electro-Chemical Engineering Company Ltd.,** comprising single- and two-stage machines fitted with either mesh belt, flight bar or overhead monorail conveyors. All machines can be supplied with drying sections if required, and they incorporate several special features not previously available in standard industrial cleaning equipment. Particular attention has been given to those design aspects affecting accessibility, maintenance and safety.

In operation, the parts to be cleaned are loaded on to the conveyor and carried through a steel canopy, where they are sprayed from top, sides and bottom with pump-circulated cleaning agent from stainless steel nozzles adjusted to give the maximum coverage of the work. Full width, roller mounted sliding doors and a translucent glass fibre roof hatch improve access to the canopy interior. Vertical monoblock pumps are employed which eliminate external pipework and gland spillage. The two canopy openings are provided with internal lip extraction ducts, connecting into fume extraction stubs mounted on top of the machine. The standard range of sizes includes conveyor widths of 18 in., 24 in. and 30 in. for the belt and flight bar machines. Variable speed drives and special heavy duty conveyors are available as optional extras. The illustration on this page shows a single-stage, flight-bar conveyor industrial spray washing machine.

Industrial Safety

What is stated to be the largest number of delegates ever to attend a post-war national conference on industrial safety met in Scarborough recently for the **National Industrial Safety Conference** organized by the Royal Society for the Prevention of Accidents. Approximately 1,000 safety specialists from every branch of British industry attended to hear information on the latest accident prevention techniques and to exchange experiences and views with colleagues from other industries and Government factory inspectors.

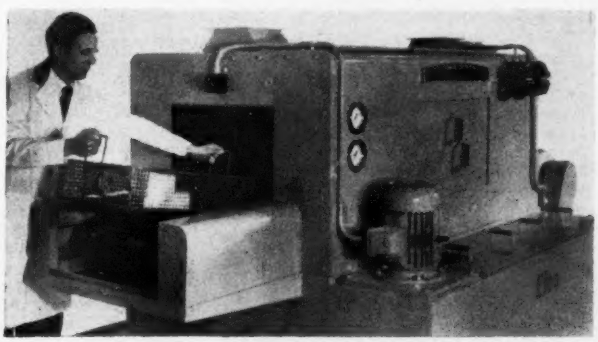
The conference was opened by Sir George Barnett, who described some of the work carried out by the Industrial Safety Division of the Society over the previous year. At the conclusion of his address, Sir George presented the Sir George Earle Trophy to this year's winner, Vauxhall Motors Ltd.

Over fifty firms supplying such industrial safety equipment as clothing, machine guards, barrier creams and skin cleansers exhibited their products during the period of the conference.

Canadian Expansion Plans

It was announced in Montreal recently by the Aluminum Company of Canada Limited that the capacity of its sheet mill at Kingston, Ontario, will be increased by 10,000 tons per year. The Kingston plant has been in operation for 19 years, producing aluminium sheet, foil, forgings, tubing, structural shapes, architectural shapes and other extrusions. The expansion of the sheet rolling facilities, Alcan said, is being made in an effort to satisfy the growing demand in Canada for this product.

The increased capacity will be obtained by the addition of some new equipment and alterations to existing equipment, at



A single-stage, flight-bar conveyor industrial spray washing machine by Electro Chemical Engineering Co. Ltd.

an estimated cost of 2,000,000 dollars. No new building construction is involved.

B.S.C.R.A.

At the Foundry Exhibition, held in Birmingham this week, the main exhibit of the **British Steel Castings Research Association** is the new fettling bench, developed and designed by the association, which is the subject of British Patent application No. 5725/59. This new bench incorporates an effective dust control system and, furthermore, makes possible a marked reduction of the noise level, particularly when dressing castings with a pneumatic chisel.

An Appointment

It has been announced by the board of management of **The Royal Commercial Travellers' Schools,** that Mr. Philip Watters Westbrook has kindly accepted office as Appeal President of the Schools for the year 1959-60.

Die-Casting Exhibition

In conjunction with the Light Metal Founders' Association, the Zinc Alloy Die-Casters' Association is sponsoring an international exhibition of pressure die-castings, open to the public, at the Birmingham Engineering Centre, Stephenson Place, Birmingham, during the period from June 15 to 19 next.

The castings to be shown will be in zinc alloy and in aluminium, magnesium, tin and copper alloys, and are drawn from the United Kingdom and many European countries. The castings are being provided by members of the European Pressure Die Casting Committee, and after this exhibition will be displayed in the main industrial centres of Europe. They represent a wide range of applications, designs and finishes, and illustrate many new aspects of die-casting, including some examples of vacuum die-castings. The exhibits range from miniature, intricate parts to large crankcases and gearboxes.

Electroplating in Australia

An interesting piece of news reaches us from Australia, where **Glen Walker and Company Pty. Ltd.** have just been appointed sole Australian agents for the Hanson-Van Winkle-Munning Company of New Jersey, U.S.A.

The Australian company has commenced production of addition agents under the names of "Nickel-Lume," "Levelume," and H.V.W.M. bright cyanide copper, while at the same time the polishing compounds, in both bar and liquid form, of the American company are being made available to the Australian metal finishing industry.

Sheffield Exhibition

What is probably the largest exhibition ever to be staged by a single company in the Cutlers' Hall, Sheffield, will be opened on Monday next, June 1, by the Master Cutler at a preview to which 150 guests from industry and the metallurgical world have been invited. Staged by the **Mond Nickel Company Limited,** the exhibition, which will be open from June 2 to 5, has been designed to demonstrate the properties of nickel, nickel-containing materials, the platinum metals, spheroidal graphite cast iron, to engineers, technologists and students.

A feature of the exhibition will be the large number of working models used to illustrate the properties and uses of the company's products. Sections deal with mechanical and physical properties, corrosion resistance, electrodeposition, strength at high temperatures, toughness at sub-zero temperatures, and welding. Each day a number of technical films will be shown.

Sheet Metal Guillotines

Details of an entirely new range of precision all-steel frame guillotine shearing machines, to be marketed under the registered trade name of "Besco Truecut," have been announced by **F. J. Edwards Ltd.** The range comprises seven models: 6 ft. and 8 ft. machines to shear up to 14 s.w.g. mild steel sheet, and 3, 4, 6, 8 and 10 ft. machines to shear plate up to ¼ in. thick. Non-ferrous metals and a wide variety of other materials can also be sheared.

A distinctive feature is the adoption of an electrically operated friction clutch and brake, with worm reduction gearbox drive giving absolute precision in the control of the cutting beam. All models are supplied with a high-slip motor for standard three-phase supply.

Theft of Metal

It is learned from the National Association of Non-Ferrous Scrap Metal Merchants that the following items were stolen between 1.30 p.m. on May 22 and 9.30 a.m. on May 23 from British Tin Smelting Company Ltd., of Hawthorn Road, Litherland, Liverpool:—9 ingots, fire refined—copper 99·5 per cent. Each ingot weighs 45 lb. and has measurements of 22 in. by 4 in. Three were notched and four had drill holes in them. All the ingots were branded H.A.W.

Any assistance which members of the trade can give as regards this theft should be communicated to the Lancashire Constabulary, Seaforth Division—telephone Waterloo 2211.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses at the end of last week fell 112 tons to 8,115 tons, distributed as follows: London 4,961, Liverpool 2,160, and Hull 994 tons.

Copper stocks rose 250 to 11,516 tons, distributed as follows:—London 2,197, Liverpool 4,269, Birmingham 775, Manchester 3,800, and Hull 475 tons.

Open Days

Yesterday (Thursday) and to-day have been kept as "Open" days by the **British Cast Iron Research Association,** and many representatives from industry are visiting the association's headquarters at Bordesley Hall, Alvechurch, where important developments are being made available for inspection.

The first of these is the new laboratory to accommodate the work of the Foundry Atmospheres Section. For the first time, the research staff and the advisory staff of this section are housed together under one roof in a building which was formally opened on Thursday by Dr. J. G. Pearce, C.B.E. This new building contains instrument rooms and a large open laboratory in which full-scale ventilation and air movement tests can be carried out. It will be possible to make investigations on prototype extraction systems, and to study in detail the whole problem of dust production, dispersal and control. The work is now extended to cover problems arising under the Clean Air Act.

On Thursday afternoon, Mr. E. Player, C.B.E., President of the Association, inaugurated the new cupola furnace in the experimental foundry. This is a 30 in. diameter lined furnace, equipped with a wet grit arrester, and incorporating some novel features. It is fully instrumented and can be operated as a cold blast furnace or as a hot blast unit with the blast preheated to 800°C.

Films were also shown during the two days dealing with the work of the Foundry Atmospheres Section, also a film on the formation of surface patterns on liquid cast iron. Visitors also have been able to inspect the research and development investigations in progress in the various departments at Bordesley Hall.

Japanese Metals Output

News from Tokyo is to the effect that the Ministry of International Trade and Industry recently stated that the output both of electrolytic copper and electrolytic lead in April sharply increased over the output in March, and both registered all-time high records. The increase of output in these metals was due to the efforts on the part of producers to recover the loss in output, which was sustained in March owing to the strikes by the non-ferrous metal workers, and also to meet notably increased demand for the products because of a scarcity of goods caused by decreased supply owing to strikes. But the total output of lead in April decreased as the output of lead by other methods than electrolysis showed a sharp decrease.

The output of electrolytic zinc and distilled zinc in April also showed a notable increase, partly because the output in March was unusually small owing to the strikes by the workers.

Malayan Tin

According to the Singapore Chinese daily "Sin Chew Jit Poh" (Singapore Daily News), the Malayan tin industry is unlikely ever to reach its old heights of prosperity. The reasons are international output restrictions and the exhaustion of mines. "The cruel reality in this country is that we can hardly hope to restore the previous full employment of 30,000 people in the tin mining industry," the paper said. "Even if international tin output restrictions are relaxed, it is very doubtful if some medium and small mines can resume production.

"It appears that the newly-established industries of iron, bauxite and rare metal mining are unable to absorb all unemployed tin workers. Their chances of employment lie in agriculture and forestry," the paper declared.

Continuous Cast Bronzes

A useful brochure has just been issued by **Enfield Rolling Mills Ltd** dealing with "Encon" continuous cast bronzes for production and maintenance in the engineering industry. A wide range of cast rods, tubes and shapes are detailed, and over 1,000 sizes are always held in stock at the company's headquarters, and also at their provincial branches. Some examples of machined components are illustrated, material specifications quoted, and other useful data are included.

Compressed Air Dehydration Unit

A machine which can supply an uninterrupted flow of air to zero humidity and clean to 0·5 micron, which is also fully portable and which, the makers state, can operate continually 365 days a year, has

recently been introduced by **B.M.B. (Sales) Ltd.** These are among the features of the Pathfinder air pump cabinet, originally developed for the Ministry of Supply and now available for the first time in a commercial version. In its standard form, the cabinet supplies 10 ft^3/min. of air at up to 60 lb/in^2 or 10 ft^3/min. at 15 lb/in^2 at any required humidity between zero and ambient. Occupying a floor area of less than 3 ft^2, under 6 ft. in height, and fitted with castors, it can be moved easily from one workshop or laboratory to another.

To summarize the main features of this new Pathfinder cabinet, it provides air dehydration to a dewpoint of $-40°$C. (or approaching $-50°$C. for special applications) at pressures of 15-60 lb/in^2, with flows up to 20 ft^3/min. obtained with either the alternative rotary compressor or an additional outside supply. The complete unit can be operated manually independent of the normal time-control, and the air is available only 30 min. after switching on. Total horse power, including the refrigerant plant, is only 3½ h.p.

The applications for the cabinets are innumerable and include the pressurization of clean assembly cabinets, film drying cabinets and nitrogen-controlled atmosphere cabinets (in place of the nitrogen supply); the production of dry air for laboratory, clinical and hospital uses; the dehydration, during manufacture, of refrigeration components and electrical components such as valves, transistors and printed circuits; the supply of compressed air for paint spraying, to prevent blistering during high temperature stoving processes; the cooling of moulds in the plastics industry; and the supply of air to pneumatically controlled equipment such as drills.

D.S.I.R. Committee

A committee to review current research needs on the fatigue of engineering structures, and to survey existing research facilities, has been set up by the Council for Scientific and Industrial Research following an approach from the Institution of Civil Engineers. The committee will not include aircraft structures, reinforced concrete structures or metal physics in the scope of their review, though information gained in these fields will be used.

The committee's terms of reference are: "To review current research needs on fatigue of engineering structures (metal) to survey existing research facilities, and to make recommendations to the D.S.I.R."

Shotblasting Equipment Demonstrated

Concurrently with the Foundry Trades Equipment Exhibition in Birmingham, a demonstration of Tilghman "Wheelabrator" and other shotblasting equipment has been organized by **R. J. Richardson and Sons Ltd.** at their Commercial Street, Birmingham, works.

Among the equipment on show is the company's own shotblasting plant, which includes W.T.B.1 and W.T.B.2 machines, for medium sized work, and a W.T.B.0 machine, for smaller work. There are also a large section cleaning machine for rails, heavy sections and the like; a W.S.T.6 table machine with a 6 ft. diameter table, for cleaning large castings; two rotary table machines (one with five 18 in. dia. tables, another with four 48 in. dia. tables); a C.B.2D air-operated barrel for use with "Blastyte" abrasive for fine finishes; and a shot peening machine for special treatment of airscrews and components where physical properties can be improved by this means. A further four-cabinet type machines are in use for general work, and a 30 ft. room is available for dealing with heavy fabrications and castings up to 10 tons.

In conjunction with the shotblasting machines, some recent developments in dust arresting plant are on show, and there are also working models of large installations for stainless steel strip, automobile parts, and other components.

The demonstration also includes examples of lifting tackle by Rowland Priest and "Welwyn" abrasive saws.

First Aid in Factories

Changes in the contents of first aid boxes or cupboards in factories, and in the advice given on first aid treatment, are provided under a new Order published this week which will come into operation on January 1 next year. It is the First Aid Boxes in Factories Order, 1959, made by the Minister of Labour and National Service under Section 45 of the Factories Act, 1957, and it will replace the current Order made in 1938

The Order specifies the minimum contents for first aid boxes or cupboards in three categories of factory—those employing 10 persons or less, those employing more than 10 but not more than 50, and those employing more than 50. The same range of equipment is now to be included in each box, but the quantities vary according to the number of persons employed. The Order is published by H.M. Stationery Office, price 3d. net.

Clover Leaf Magnet

A new lifting magnet to facilitate the handling of coiled mild steel strip and the like has been introduced by **Rapid Magnetic Machines Ltd.** This unit consists of a number of magnets mounted on a common framework, and adjustable so as to cover various coil diameters.

Heavy Plate Levellers

An order from Davy and United Engineering Co. Ltd. for one roller leveller to handle cold plates up to ¾ in. thick by 10 ft. 6 in. wide, and a roller leveller to handle hot plates up to 1½ in. thick and 10 ft. 6 in. wide, has been received by the **Head Wrightson Machine Co. Ltd.**, a subsidiary of Head Wrightson and Co. Ltd. These levellers will form part of the new plate mill which is to be installed at the works of the Consett Iron Co. Ltd.

In addition, orders have recently been received by the company from the South Durham Steel and Iron Co. Ltd. for two roller levellers, which will be installed in the plate mill of their new south works at West Hartlepool.

Birlec Dryers for Nuclear Power

News from **Birlec Limited** is to the effect that an order has recently been placed with the Dryer and Gas Plant Division of the company for two dryers to be supplied for the Italian nuclear power station under erection at Latina.

A Flexible Tariff Policy

It is understood that the Copper and Brass Research Association has recommended that the United States impose a flexible tariff policy to enable domestic basic industries, such as the brass mills, "to compete on even terms with foreign suppliers in U.S. markets." In a comprehensive study just released, the Association contends that the U.S. "dollar gap" policy "forces domestic brass mills to compete with foreign mills which pay wages at rates which would be unlawful in this country."

The dollar gap policy also was unwise, the study said, because friendly nations shipping brass mill products to the U.S. were being led down a blind alley. "Ultimately," it noted, "a halt must be called to these imports in order to preserve an essential domestic industry; if these friendly exporting nations have, in the meantime, built up their brass mill capacity on the expectation of selling in American markets, the blow to them will be much more severe in the future than now."

The report pointed to an alarming growth in brass mill imports, with the loss of almost 100 per cent of certain markets such as tubular plumbing goods; the conversion of U.S. from a net exporter to a net importer of brass mill products; the gradual displacement of U.S. brass mill labour with foreign labour which was paid only a fraction of U.S. wage rates. The report called for the imposition of a flexible tariff on imported brass mill products which would merely equalize the wage disparity between foreign and domestic producers.

Conductivity Measuring Bridge

Among new developments recently announced by **Electronic Switchgear (London) Ltd.** is the Mark III portable, electrolytic conductivity measuring bridge. This instrument embodies a number of important improvements upon its predecessor and should prove of much value to water purification engineers and their service technicians, chief chemists and engineers concerned with the instrumentation of steam raising plant throughout the country.

The new bridge is provided with a finely divided, silvered measuring dial which is indexed by a hairline "Perspex" cursor which enables measurements to be read with very precise accuracy; a printed ivorine instruction panel now appears on the inside of the detachable hardwood cover of the case, and a shoulder strap has been provided for the use of operators who have occasion to carry out routine tests on measuring cells placed at strategic points throughout the plant. The small dry battery, which energizes the transistorized circuits, is now contained beneath a detachable cover within the accessory compartment—this modification permits the battery to be renewed without the inconvenience of removing the instrument panel.

Hints for Authors

Under this title, the **Institute of Physics** has just published a 36-page revised edition of its booklet to assist less experienced authors and to serve as a reference booklet for all those who wish to contribute to the Institute's publications.

The revised booklet gives hints on the preparation of scripts and diagrams, on the layout of mathematics, correction of proofs and the like. In addition to a bibliography of reference books and works on technical writing, the booklet also contains lists of the spellings, symbols and abbreviations used by the Institute. Such a booklet is of equal value to the writer who may wish to contribute articles to the technical press. Copies of the booklet are obtainable, price 3s. 6d., from the offices of the Institute at 47 Belgrave Square, London, S.W.1.

Metal Market News

THE trend of L.M.E. stocks continues, and last week brought news that the reserves of copper in L.M.E. official warehouses were up by 350 tons to 11,266 tons, which is the highest figure since the end of August last year when the figure was 11,492 tons. In tin, there was a fall of 295 tons to 8,227 tons, which is the lowest figure reported since the end of November 1957. In spite of this rise in copper stocks, a backwardation appeared on the standard copper market on Thursday which was apparently due to keen buying of the cash position by dealers short of cover. The week opened with a contango of 25s., and the change round to a backwardation is very disappointing from the point of view of hedging against a long position.

It is equally unfortunate for those who stress the advantages of a free market against the claims made for a "managed" price, about which a good deal has recently been heard. As always, there has been talk about the possibility of the backwardation widening considerably, and this makes operators nervous if they are maintaining a short position in futures. All these uncertainties add up to encourage adverse criticism of the Metal Exchange in its workings, but critics should remember the manifold disadvantages of a situation where values are arbitrarily fixed by producers. This, presumably, would be the position under a scheme which by-passed the Metal Exchange.

Last Friday saw an intensification of the upthrust of the cash position through keen buying, and as a result the backwardation widened to 30s. on the midday market, when cash jumped up to £241 10s. 0d., with three months at £240, the turnover on the midday market being some 1,600 tons. On the Kerb, the prompt price fell away by 10s. to £241 sellers. The firm tone of the London market was not without its effect on other centres, and on Friday the Belgian price was reported up to 33¼ francs per kilo. The trend of Comex was upwards last week and the market made a good showing, with a total turnover if not as large as on some previous occasions then certainly in excess of London. In Whittington Avenue, trading in the copper ring was rather below average, even allowing for a four-day week, the total changing hands being 8,300 tons. On balance, cash gained £6 5s. 0d. and three months £3 15s. 0d., the backwardation at the end of the week being 25s. In tin, some 835 tons changed hands, with a gain of £1 in cash and of 10s. in three months. Lead was quiet, with a turnover of 4,500 tons, May losing £1 and August 22s. 6d. at £70 15s. 0d. and £71 5s. 0d. for the respective positions.

Zinc has put up a good show for some time now, and last week saw the current month up by 10s. to £78 15s. 0d., while August advanced by only 5s. to £76 15s. 0d. The turnover was 6,600 tons. Consumption of zinc in the U.K. in March, as reported by the British Bureau of Non-Ferrous Metal Statistics was 27,243 tons, against 25,676 tons in February. Stocks at 38,457 tons were up by about 1,600 tons. Lead usage at 26,691 tons showed a rise of about 700 tons. Stocks were 2,200 tons up at 42,761 tons. Copper consumption, at 47,431 tons, reversed the trend in lead and zinc, for the February total was 48,293 tons, and we must remember that this was a short month.

The downward drift of copper usage in the U.K. seems to be due almost entirely to a falling off in the activity of the wire mills. At the same time, the drop in March showed up in secondary metal, for the comparative figures were 11,307 tons against 12,518 tons. Refined copper usage, at 36,124 tons, compared with 35,775 tons in February. Stocks, at 72,946 tons, were fully 7,000 tons up on the previous month.

New York

On the Commodity Exchange, copper was firmer, and lead and zinc steady. Conditions in physical copper were little changed. Custom smelters indicated more demand at 32 cents than they could handle. Their offerings, however, were modest. Traders said the dealer market price was 33 to 33¼ cents a lb., but business being done was negligible. There is a definite squeeze on copper for delivery before July 1 but no interest in copper after that date, trade sources said. Producer copper continued tight for nearbys. Lead was quieter, but zinc active. Tin was firmer, but business modest.

Birmingham

The latest returns of unemployment in the industrial towns of Birmingham, Coventry and Wolverhampton show another substantial fall. In Birmingham alone, the city's unemployed total has fallen by 3,500 in a month. Motor car manufacturers are making new records as far as production is concerned and, with so many cars being shipped each month, waiting lists similar to those in the early post-war period, have been introduced in the home market, and home buyers have to wait as long as four months in some cases for delivery. In other metal-using industries the outlook is brighter than it has been for some time. There is a better tone in the export trade, despite severe competition.

In the iron and steel industry the improvement of the last few weeks has been maintained. In some cases delivery dates have been lengthened, a sure indication of additions to order books.

There is bigger consumption of semi-finished steel following better business in small bars and sections. Sheets are a strong market, and makers supplying sheets for the motor trade are working to maximum capacity. There is still slackness as far as demand for heavy joints and sections is concerned. Although fewer furnaces are in blast, the supply of pig iron is ample for all requirements. A substantial tonnage is absorbed for heavy engineering castings.

Israeli

Albar rolling mill, an I£3,500,000 rolling mill for non-ferrous metals, which will manufacture up to 4,000 tons of aluminium products annually, was opened recently in Jerusalem. Present at the opening ceremony was M. Georges Perrot, the President of the Coquillad Aluminium Company of France, which supplied most of Albar's machinery. The new factory is expected to supply most of Israel's consumption in aluminium products, and export up to 2,000 tons of aluminium products. The plant now produces aluminium foil, including a foil of a thinness of 0·008 mm., and aluminium kitchen utensils. The main raw material will be aluminium scrap, of which an estimated 60 per cent will be collected in Israel. In the future, the plant intends to produce utensils of copper, bronze and brass. The investors are a group of Israeli and foreign industrialists.

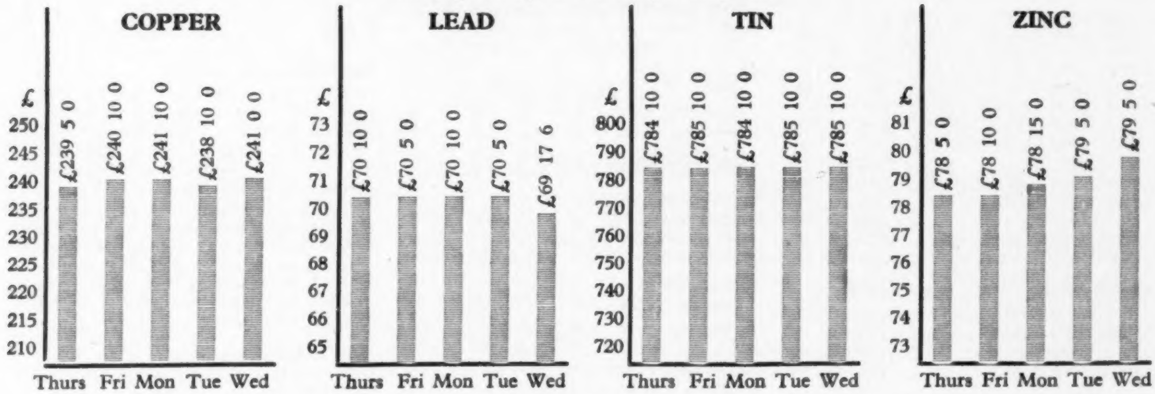
Zurich

Demand tended to rise on the Swiss non-ferrous metal market during the past fortnight. According to trade quarters, this increase in buying interest was mainly due to the firmer tone prevailing on foreign markets, but partly also to a slight improvement in domestic economic conditions. The increase in demand was most accentuated for tin, which is hard to get; users believe that tin prices will continue to rise. Interest in lead and zinc also rose on the output reductions agreed upon by the recent United Nations meetings. Demand for copper improved slightly. In consequence of the enhanced demand, prices of tin, lead, zinc and copper also rose during the period under review, while the nickel and aluminium prices remained unchanged.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 21 May to Wednesday 27 May 1959



Primary Metals

All prices quoted are those available at 2 p.m. 27/5/59

		£	s.	d.
Aluminium Ingots....	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%..	„	190	0	0
Antimony Oxide......	„	180	0	0
Antimony Sulphide Lump..............	„	190	0	0
Antimony Sulphide Black Powder........	„	205	0	0
Arsenic..............	„	400	0	0
Bismuth 99·95%......	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite.... per unit		—		
Copper H.C. Electro..	ton	241	0	0
Fire Refined 99·70%	„	240	0	0
Fire Refined 99·50%	„	239	0	0

		£	s.	d.
Copper Sulphate	ton	76	0	0
Germanium	grm.		—	
Gold	oz.	12	9	7¼
Indium	„		10	0
Iridium..............	„	24	0	0
Lanthanum	grm.		15	0
Lead English..........	ton	69	17	6
Magnesium Ingots....	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4.......	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal....	ton	245	0	0
Mercury	flask	77	10	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%..........	ton		nom.	
Silver Spot Bars......	oz.		6	7⅛
Tellurium	lb.		15	0
Tin	ton	785	10	0
***Zinc**				
Electrolytic..........	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	78	5	7½
Dust 95/97%........	„	109	0	0
Dust 98/99%........	„	115	0	0
Granulated 99+% ..	„	103	5	7½
Granulated 99·99+%	„	117	5	0

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏£/ton	Canada c/lb	≏£/ton	France fr/kg	≏£/ton	Italy lire/kg	≏£/ton	Switzerland fr/kg	≏£/ton	United States c/lb	≏£/ton
Aluminium			22.50	185 17 6	224	163 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					220	165 0	445	262 10			29.00	232 0
Cadmium					1,350	1,012 10					130.00	1,040 0
Copper												
Crude												
Wire bars 99.9							460	271 10 0				
Electrolytic	33.25	244 15 0	30.50	252 0	334	250 10			3.00	255 0	31.50	252 0
Lead			10.25	84 12 6	103	78 0	170	100 7 6	.88	74 17 6	12.00	96 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	111.25	817 2 6			1,125	843 15	1,500	885 0	9.70	824 12 6	103.50	828 0
Zinc												
Prime western			11.25	92 17 6							11.00	88 0
High grade 99.95			11.85	94 0 0								
High grade 99.99			12.25	101 2 6								
Thermic					114.00	85 12 6						
Electrolytic					122.00	91 12 6	177	104 10	1.02	86 17	12.25	98 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 27/5/59

Aluminium Alloy (Virgin)

		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	,,	202	0	0
B.S. 1490 L.M.7	,,	216	0	0
B.S. 1490 L.M.8	,,	203	0	0
B.S. 1490 L.M.9	,,	203	0	0
B.S. 1490 L.M.10	,,	221	0	0
B.S. 1490 L.M.11	,,	215	0	0
B.S. 1490 L.M.12	,,	223	0	0
B.S. 1490 L.M.13	,,	216	0	0
B.S. 1490 L.M.14	,,	224	0	0
B.S. 1490 L.M.15	,,	210	0	0
B.S. 1490 L.M.16	,,	206	0	0
B.S. 1490 L.M.18	,,	203	0	0
B.S. 1490 L.M.22	,,	210	0	0

†Aluminium Alloys (Secondary)

		£	s.	d.
B.S. 1490 L.M.1	ton	153	0	0
B.S. 1490 L.M.2	,,	163	0	0
B.S. 1490 L.M.4	,,	178	0	0
B.S. 1490 L.M.6	,,	189	0	0

***Aluminium Bronze**

		£	s.	d.
BSS 1400 AB.1	ton	234	0	0
BSS 1400 AB.2	,,	246	0	0

***Brass**

		£	s.	d.
BSS 1400-B3 65/35 ..	ton	156	0	0
BSS 249	,,		—	
BSS 1400-B6 85/15 ..	,,	207	0	0

***Gunmetal**

		£	s.	d.
R.C.H. 3/4% ton	,,		—	
(85/5/5/5) LG2	,,	196	0	0
(86/7/5/2) LG3	,,	204	0	0
(88/10/2/1)	,,	245	0	0
(88/10/2/½)	,,	259	0	0

***Manganese Bronze**

		£	s.	d.
BSS 1400 HTB1	,,	189	0	0
BSS 1400 HTB2	,,	206	0	0
BSS 1400 HTB3	,,	213	0	0

Nickel Silver

		£	s.	d.
Casting Quality 12%	,,	225	0	0
,, ,, 16%	,,	235	0	0
,, ,, 18%	,,	245	0	0

***Phosphor Bronze**

		£	s.	d.
B.S. 1400 P.B.1.(A.I.D. released)	,,	292	0	0
B.S. 1400 L.P.B.1	,,	214	0	0

**Average prices for the last week-end.*

Phosphor Copper

		£	s.	d.
10%	ton	253	0	0
15%	,,	255	10	0

Phosphor Tin

		£	s.	d.
5%	,,		—	

Silicon Bronze

		£	s.	d.
BSS 1400-SB1	,,	250	0	0

Solder, soft, BSS 219

		£	s.	d.
Grade C Tinmans	,,	365	0	0
Grade D Plumbers ..	,,	293	10	0
Grade M	,,	400	15	0

Solder, Brazing, BSS 1845

		£	s.	d.
Type 8 (Granulated)	lb.		—	
Type 9 ,,	,,		—	

Zinc Alloys

		£	s.	d.
Mazak III	ton	110	10	0
Mazak V	,,	114	10	0
Kayem	,,	120	10	0
Kayem II	,,	126	10	0
Sodium-Zinc	lb.		2	6¼

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium

		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8¼
Sheet 18 S.W.G.	,,		2	10¼
Sheet 24 S.W.G.	,,		3	1¼
Strip 10 S.W.G.	,,		2	8¼
Strip 18 S.W.G.	,,		2	9¼
Strip 24 S.W.G.	,,		2	11
Circles 22 S.W.G.	,,		3	2¼
Circles 18 S.W.G.	,,		3	1¼
Circles 12 S.W.G.	,,		3	0¼
Plate as rolled	,,		2	8
Sections	,,		3	2
Wire 10 S.W.G.	,,		2	11¼
Tubes 1 in. o.d. 16 S.W.G.	,,		4	1

Aluminium Alloys

		£	s.	d.
BS1470. HS10W.				
Sheet 10 S.W.G.	,,		3	1
Sheet 18 S.W.G.	,,		3	3¼
Sheet 24 S.W.G.	,,		3	11
Strip 10 S.W.G.	,,		3	1
Strip 18 S.W.G.	,,		3	2¼
Strip 24 S.W.G.	,,		3	10¼
BS1477. HP30M.				
Plate as rolled	,,		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	,,		3	9¼
Sheet 18 S.W.G.	,,		4	2
Sheet 24 S.W.G.	,,		5	0¼
Strip 10 S.W.G.	,,		3	10¼
Strip 18 S.W.G.	,,		4	2
Strip 24 S.W.G.	,,		4	9¼
BS1477. HPC15WP.				
Plate heat treated ..	,,		3	6¼
BS1475. HG10W.				
Wire 10 S.W.G.	,,		3	10¼
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	,,		5	0¼
BS1476. HE10WP.				
Sections	,,		3	1¼

Brass

		£	s.	d.
Tubes	,,		1	10⅞
Brazed Tubes	,,		—	
Drawn Strip Sections	,,		—	
Sheet	ton		—	
Strip	,,	258	10	0
Extruded Bar	lb.		2	0⅞
Extruded Bar (Pure Metal Basis)	,,		—	

Brass

		£	s.	d.
Condenser Plate (Yellow Metal)	ton	194	0	0
Condenser Plate (Naval Brass)	,,	206	0	0
Wire	lb.		2	8¼

Beryllium Copper

		£	s.	d.
Strip	,,	1	4	11
Rod	,,	1	1	6
Wire	,,	1	4	9

Copper

		£	s.	d.
Tubes	lb.		2	4
Sheet	ton	268	15	0
Strip	,,	268	15	0
Plain Plates	,,		—	
Locomotive Rods	,,		—	
H.C. Wire	,,	292	5	0

Cupro Nickel

		£	s.	d.
Tubes 70/30	lb.		3	7⅞

Lead

		£	s.	d.
Pipes (London)	ton	111	5	0
Sheet (London)	,,	109	0	0
Tellurium Lead	,,	£6 extra		

Nickel Silver

		£	s.	d.
Sheet and Strip 7% ..	lb.		3	8
Wire 10%	,,		4	2¾

Phosphor Bronze

		£	s.	d.
Wire	,,		4	1⅝

Titanium (1,000 lb. lots)

Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-
Rod 4″ dia.-·250″ dia.	,,	75/-	112/-
Wire under ·250″ dia.-·036″ dia.	,,	146/-	222/-
Sheet 8′ × 2′ × ·250″-·010″		88/-	157/-
Strip ·048″-·003″	,,	100/-	350/-
Tube	,,		300/-
Extrusions	,,		120/-

Zinc

		£	s.	d.
Sheet	ton	113	15	0
Strip	,,	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 26/5/59.

Aluminium

	£
New Cuttings	146
Old Rolled	126
Segregated Turnings	98

Brass

	£
Cuttings	157
Rod Ends	147
Heavy Yellow	126
Light	122
Rolled	149
Collected Scrap	126
Turnings	138

Copper

	£
Wire	217
Firebox, cut up	214
Heavy	209
Light	204
Cuttings	217
Turnings	197
Braziery	165

Gunmetal

	£
Gear Wheels	185
Admiralty	185
Commercial	167
Turnings	162

Lead

	£
Scrap	61

Nickel

	£
Cuttings	—
Anodes	550

Phosphor Bronze

	£
Scrap	167
Turnings	162

Zinc

	£
Remelted	68
Cuttings	53
Old Zinc	38

Financial News

Ether Limited

Application has been made to the Council of the Stock Exchange for permission to deal in and for quotation for the whole of the issued share capital of this Birmingham company. The authorized capital of £250,000 is in Ordinary shares of 5s. each. The company has no debentures, mortgages or other loan capital outstanding.

General Electric Co. Ltd.

It has been announced that a long-term agreement for the supply of "know-how" and patents for nuclear power stations has been signed by the G.E.C. with one of the leading German heavy engineering groups, the M.A.N. of Nuremberg. It is understood that the G.E.C. will receive a cash payment plus a service fee per kilowatt of nuclear power station output installed by the German company. In return, any inventions which M.A.N. may make relating to nuclear power plant will be made available to General Electric.

John Dale Ltd.

The annual general meeting of the company will be held in London on June 17 next. In the course of his circulated statement, the chairman, Mr. Robert Carr, M.P., F.I.M., says that the trading conditions with which the company had to contend in 1958 were undoubtedly more difficult than for many years past. In the United Kingdom, the Packaging Divisions more than maintained their sales, but the Light Alloy Foundries, in common with other producers, suffered a substantial contraction in the demand for their products. With production and overhead expenditure continuing to rise the result was a sharp contraction in profits. Impact Extrusions Limited, which was acquired in April, 1958, made a profitable contribution to the year's results. In Canada, Modern Containers Limited succeeded in increasing both their sales and profits in spite of severe competition. John Dale (Canada) Ltd. also continued to increase its business.

In the result 1958 was a most disappointing year. The net profit of the group after the deduction of the minority interest in the Canadian subsidiaries, but before taxation, was £115,587, compared with £300,946 in 1957. The board feel it wise to pursue a cautious dividend policy and propose the payment of a final dividend of 7 per cent, less tax, on the Ordinary share capital, making a total of 11 per cent for the year.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Horninglow Plating Co. (Burton-on-Trent) Limited (626741), Church Croft, Horninglow Street, Burton-on-Trent. Registered April 27, 1959. Nominal capital, £100 in £1 shares. Directors: Mrs. Barbara J. Cooper, Richard B. Cooper and John G. Cooper.

Rotarstrip Metal Co. Limited (626806), Hillside, Stonebridge, N.W.10. Registered April 27, 1959. Nominal capital, £100 in £1 shares. Directors: Wm. J. Finucane, Francis C. Finucane and Eric E. Knight.

J.K. Metal Products Limited (626993), 493 Cambridge Heath Road, E.2. Registered April 29, 1959. Nominal capital, £100 in £1 shares. Directors: Joseph Freedman, Jacob Karno and Gerald Fraser.

W. F. Manthorp and Co. Limited (627018), 3 Pennywell Road, Bristol, 5. Registered April 29, 1959. To carry on business of recovery of all kinds of salvage, particularly ferrous and non-ferrous metals, etc. Nominal capital, £7,500 in £1 shares. Directors: Wm. F. Manthorp and Mollie Manthorp.

Scrap Metals (M/cr.) Limited (627264), 75-7 Atlantic Chambers, 7 Brazennose Street, Manchester, 2. Registered May 1, 1959. Nominal capital, £100 in £1 shares. Directors: Chas. I. Abrahams and Morris Woolfson.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£205.17.6)	235
Heavy copper	(£201.10.0)	230
Light copper	(£175.5.0)	200
Heavy brass	(£118.5.0)	135
Light brass	(£92.0.0)	105
Soft lead scrap	(£57.0.0)	65
Zinc scrap	(£36.15.0)	42
Used aluminium unsorted	(£83.5.0)	95
France (francs per kilo):		
Electrolytic copper scrap	(£191.5.0)	255
Heavy copper	(£191.5.0)	255
No. 1 copper wire	(£180.0.0)	240
Light brass	(£112.12.6)	150
Zinc castings	(£48.15.0)	65
Lead	(£64.12.6)	86
Aluminium	(£120.0.0)	160

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£197.12.6)	335
Aluminium copper alloy	(£126.17.6)	215
Lead, soft, first quality	(£75.12.6)	128
Lead, battery plates	(£41.17.6)	71
Copper, first grade	(£215.10.0)	365
Copper, second grade	(£203.2.6)	345
Bronze, first quality machinery	(£200.15.0)	340
Bronze, commercial gunmetal	(£171.2.6)	290
Brass, heavy	(£138.15.0)	235
Brass, light	(£123.17.6)	210
Brass, bar turnings	(£127.0.0)	215
New zinc sheet clippings	(£63.2.6)	107
Old zinc	(£45.10.0)	77

Trade Publications

Scientific Instruments.—Hilger and Watts Ltd., 98 St. Pancras Way, London, N.W.1.

The latest available number of the "Hilger Journal" contains an interesting illustrated article on "Teaching Spectroscopy," as well as news and a number of notes on the firm's X-ray exhibition, etc., and an article on "Automatic Motor Drive for Plate Racking on a Hilger Littrow Spectrograph."

Mechanical Handling. — G. Hunter (London) Ltd., 80 Fenchurch Street, London, E.C.3.

This 174-page general handling catalogue covers such products as cranes, hoists, lifting tackle, jacks, conveyors, stackers, fork trucks, pallets and stillages. There are also sections on modernization of despatch bays and instructions on designing one's own gravity roller conveyor.

Non-Sparking Safety Tools. — Charles Carr Ltd., Grove Lane, Smethwick, Birmingham, 40.

A 16-page catalogue provides details, diagrams and statistical data of the wide range of non-sparking tools made by this company. These tools are available from stock in the usual popular sizes, but special designs can be made to specification.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Feb. 1959, have been issued by the Ministry of Supply as follows (in long tons):—

Virgin Aluminium	
Production	1,871
Imports	17,459
Despatches to consumers	22,675
Secondary Aluminium	
Production	8,875
Virgin content of above	1,015
Despatches (including virgin content)	9,441
Scrap	
Arisings	11,848
Estimated quantity of metal recoverable	8,200
Consumption by:	
(a) Secondary smelters	11,099
(b) Other uses	1,169
Despatches of wrought and cast products	
Sheet, strip and circles	11,737
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,577
(b) Tubes (i) extruded	147
(ii) cold drawn	459
(c) (i) Wire	2,064
(ii) Hot rolled rod (not included in (c) (i)	12
Forgings	286
Castings: (a) Sand	1,546
(b) Gravity die	3,846
(c) Pressure die	1,591
Foil	1,906
Paste	250
Magnesium Fabrication	
Sheet and strip	8
Extrusions	89
Castings	143
Forgings	7

THE STOCK EXCHANGE

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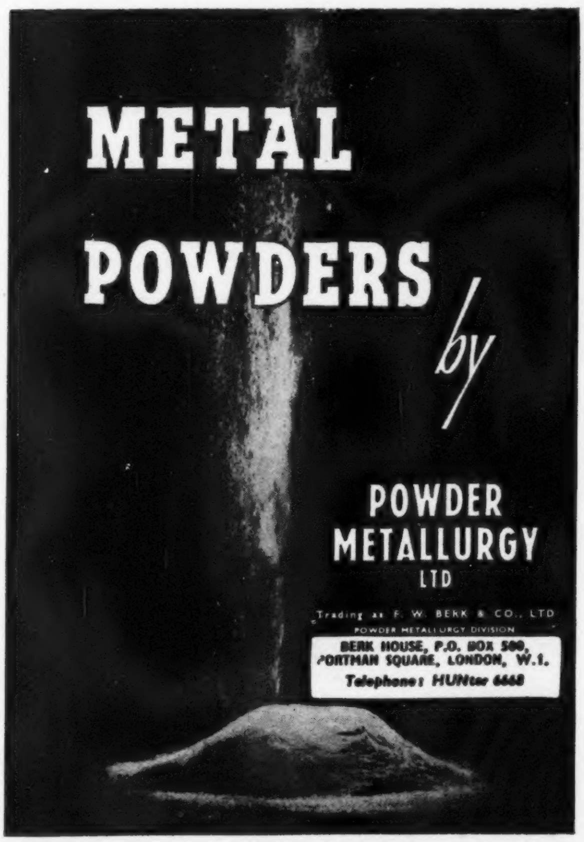
ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 26 MAY +RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	27/3	9	10	6 12 0	27/3	23/3	24/9	17/6
400,000	2/-	Anti-Attrition Metal	1/3	4	8½	6 8 0	1/6	1/3	1/9	1/3
41,305,038	Stk. (£1)	Associated Electrical Industries ...	61/9 +1/3	15	15	4 17 0	62/-	54/-	58/9	46/6
1,609,032	1	Birfield	51/3 +9d.	15	15	5 17 0	59/-	47/-	62/4½	46/3
3,196,667	1	Birmid Industries	80/- +4/-	17½	17½	4 7 6	80/6	72/-	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	43/9 +3d.	11	10	5 0 6	44/1½	36/1½	39/-	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/6	5	5	6 9 0	16/3	15/-	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/9	6	6	6 15 3	18/1½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	31/3 +1/3	10	10	6 8 0	30/-	27/6	28/9	24/-
300,000	1	Ditto Pref. 5%	15/6	5	5	6 9 0	15/6	15/-	16/-	15/-
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/-	7	7	7 0 0	—	—	20/4½	19/-
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/6	6	6	6 3 0	19/7½	18/9	20/-	18/4½
15,000,000	Stk. (£1)	British Insulated Callender's Cables	55/9 +3d.	12½	12½	4 9 6	56/-	47/6	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	62/3 +2/6	10	10	3 4 3	64/-	49/3	52/-	28/3
1,200,000	Stk. (5/-)	Canning (W.) & Co.	15/6xcap —3d.	25+*2½C‡	25	4 0 9	32/-	15/6	25/3	19/3
60,484	1/-	Carr (Chas.)	2/7½	12½	25	4 15 3	2/7½	1/3	2/3	1/4½
150,000	2/-	Case (Alfred) & Co. Ltd.	5/6	25	25	9 1 9	5/6	4/7½	5/3	4/-
555,000	1	Clifford (Chas.) Ltd.	23/6	10	10	8 10 3	23/6	22/6	22/-	16/-
45,000	1	Ditto Cum. Pref. 6%	16/-	6	6	7 10 0	16/-	15/3	16/-	15/-
250,000	2/-	Coley Metals	3/6xd —1½d.	20	25	11 8 6	4/-	2/10½	4/6	2/6
8,730,596	1	Cons. Zinc Corp.†	65/6xd +6/-	18¾	22½	5 14 6	67/6	60/-	65/3	41/-
1,509,528	1	Davy & United	103/9	20	15	3 17 0	106/3	86/-	87/-	45/9
5,830,000	5/-	Delta Metal	17/- +6d.	31‡	30	4 11 3	33/7½	16/3	25/-	17/7½
4,600,000	Stk. (£1)	Enfield Rolling Mills Ltd.	57/6 +7/-	15	12½	5 4 3	57/6	36/7½	38/-	22/9
750,000	1	Evered & Co.	32/- +6d.	10§	15Z	6 7 0	32/-	30/-	30/-	26/
18,000,000	Stk. (£1)	General Electric Co.	34/- +2/-	10P	12½		40/3	30/6	40/6	29/6
1,500,000	Stk. (10/-)	General Refractories Ltd.	34/3 +3d.	20	20	5 16 9	40/-	32/6	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	64/-xd +3d.	16½	15	5 3 3	66/6	63/6	67/6	61/-
750,000	5/-	Glacier Metal Co. Ltd.	7/3	11½	11½	7 18 6	7/3	6/7½	8/3	5/-
1,750,000	5/-	Glynwed Tubes	18/9	20	20	5 6 9	19/3	16/4½	18/1½	12/10½
5,421,049	10/-	Goodlass Wall & Lead Industries ...	38/6xd +7½d.	13‖	18Z	3 7 6	38/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	84/-	20	17½	4 15 3	84/-	75/-	57/9	45/-
396,000	5/-	Harrison (B'ham) Ord.	18/9 —3d.	*17½	*15	4 13 3	19/-	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6	7	7	7 3 6	—	—	19/9	18/4½
1,075,167	5/-	Heenan Group	8/3 +1½d.	10	10‡	6 1 3	8/6	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	34/9 +6d.	12Z	10	4 12 0	38/3	33/9	38/-	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	16/6 —3d.	5	5	6 1 3	17/1½	16/-	17/1½	16/-
14,584,025	**	International Nickel	163½ —2	$2.60	$3.75	2 17 3	171	153	169	132¾
860,000	5/-	Jenks (E. P.), Ltd.	10/7½ —1½d.	14	27½ϕ	6 11 9	10/9	8/9	10/-	6/7½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	5	5	6 3 0	16/3	15/4½	16/9	15/-
3,987,435	1	Ditto Ord	58/- —1/6	10	10	3 9 0	59/6	44/3	47/-	36/6
600,000	10/-	Keith, Blackman	30/- +1/3	17½E	15	5 16 9	30/-	25/-	28/9	15/-
320,000	4/-	London Aluminium	5/9	10	10	6 19 3	6/4½	5/3	6/-	3/-
765,012	1	McKechnie Brothers Ord.	40/9 —1/9	15	15	7 7 3	45/-	42/6	45/-	32/-
1,530,024	1	Ditto A Ord.	39/9 —9d.	15	15	7 14 9	43/6	38/9	45/-	30/-
1,108,268	5/-	Manganese Bronze & Brass	16/3	20⅝	20	6 8 3	16/3	13/9	14/1½	8/9
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-	7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk (£1)	Metal Box	80/6 +1/6	11	11	2 15 0	80/6	66/6	73/3	40/6
415,760	Stk. (2/-)	Metal Traders	9/9	50	50	10 5 3	9/9	8/4½	9/-	6/3
160,000	1	Mint (The) Birmingham	25/-	10	10	8 0 0	25/-	22/-	22/9	19/-
80,000	5	Ditto Pref. 6%	73/- +6d.	6	6	8 4 6	75/6	69/-	83/6	69/-
3,705,670	Stk. (£1)	Morgan Crucible A	46/6	10	10	4 6 0	46/6	43/6	45/-	34/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/6	5½	5½	6 5 9	18/6	17/6	18/-	17/-
2,200,000	Stk. (£1)	Murex	44/- —2/-	17½	20	7 19 3	50/-	42/-	58/9	46/-
468,000	5/-	Ratcliffs (Great Bridge)	9/9	10R	10	3 17 0	11/6	9/9	11/1½	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	37/- +5/6	20	27½D	5 8 0	37/-	27/9	27/3	24/6
1,365,000	Stk. (5/-)	Serck	20/7½xd +3d.	15	17½	3 12 9	21/-	18/-	18/7½	11/-
6,698,586	Stk. (£1)	Stone-Platt Industries	52/9 +9d.	15	12½	5 13 9	53/3	43/3	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/6	5½	5½	6 5 9	17/6	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord	87/3xd +1/-	17½	15	4 0 3	87/6	72/-	86/-	48/4½
41,000,000	Stk. (£1)	Vickers	33/7½ —1½d.	10	10	5 19 0	37/-	30/6	36/3	29/9
750,000	Stk. (£1)	Ditto Pref. 5%	14/3	5	5	7 0 3	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3	*5	*5	7 5 0A	22/7½	21/-	23/-	21/3
2,200,000	1	Ward (Thos. W.), Ord	91/9 +1/3	20	15	4 7 0	91/9	83/6	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	43/6	10	10	4 12 0	47/-	39/9	46/6	32/6
225,000	2/-	Wolverhampton Die-Casting ...	9/7½	30	25	6 4 9	10/6	8/8½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	26/6 +6d.	27½	27½	5 3 9	28/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	6/7½xd +3d.	20	20	7 5 3	6/7½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9	6	6	8 14 6	13/9	13/6	13/-	11/3
150,000	1/-	Zinc Alloy Rust Proof	3/-	27	40D	9 0 0	3/1½	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. ● The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units.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INDEX TO ADVERTISEMENTS

	Page
Alexander Metal Co. Ltd.	16
Alkan Ltd., M. L.	4
Aluminium-Bronze Co. Ltd.	*Inside back cover*
Associated Lead Manufacturers Ltd.	3
Associated Pressings Ltd.	16
Auxiliary Rolling Machinery Ltd.	10
Barnett Ltd., H.	18
Barrow Quarries Ltd.	14
Blackwell's Metallurgical Works Ltd.	*Outside front cover*
Bolton & Sons Ltd., Thomas	2
British Industrial Ingot Metals Ltd.	19
Brookside Metal Co. Ltd.	16
Canning & Co. Ltd., W.	14
Clifford, Charles, Ltd.	2
Cohen, A., & Co. Ltd.	*Outside back cover*
Consolidated Zinc Corporation (Sales) Ltd.	12
Cruickshank Ltd., R.	10
Deutsch & Brenner Ltd.	17
Entores Ltd.	18
Fescol Ltd.	8
Firma-Chrome Ltd.	8
Fine Tubes Ltd.	16
Frost Ltd., N. T.	20
Hampton Works (Stampings) Ltd.	14
Harris Plating Works Ltd., The	8
Ilfar Aluminium Co. Ltd.	8
Iliffe & Sons Ltd.	17
Industrial Research Laboratories	18
International Alloys Ltd.	9
International Refining Co. Ltd.	15
Johnson & Co. (Birmingham) Ltd., George	14
Jones & Rooke (1948) Ltd.	*Inside back cover*
Joseph & Son (Birmingham) Ltd., M.	13
Lazarus Ltd., Leopold	*Inside front cover*
Lead Development Association	18
Levy & Co. (Patterns) Ltd., B.	18
Magnesium Elektron Ltd.	18
Mellor Mineral Mills Ltd.	5
Metal Castings Ltd.	6
Milner (Metals) Ltd., A. E.	15
Mitcham Smelters Ltd.	19
Modern Furnaces & Stoves Ltd.	17
Monometer Manufacturing Co. Ltd.	7
Platt Metals Ltd.	13
Powder Metallurgy Ltd.	13
Priestman Ltd., T. J.	14
Senier & Co. Ltd., T. W.	15
Shardal Castings Ltd.	20
Stuart (London) Ltd., Robert	8
Vickers-Armstrongs Ltd.	4
Wolverhampton Metal Co. Ltd.	1

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